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MEASUREMENT OF ADAPTER LOSS, MISMATCH, AND EFFICIENCY USING THE DUAL SIX-PORT

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CONTENTS

Page

ABSTRACT.....1

I. INTRODUCTION.....2

II. EQUIPMENT USED.....2

III. SOFTWARE.....7

IV. MAKING A MEASUREMENT.....9

A. GENERAL OVERVIEW OF THE MEASUREMENT PROCESS.....9

B. DATA STORAGE AND USE.....11

C. RUNNING THE PROGRAM.....14

V. REFERENCES.....22

VI. ACKNOWLEDGMENTS.....22

APPENDIX I LISTING OF ADAPTER PARAMETER CALCULATING SUBPROGRAM "FNAdp".....23

APPENDIX II LISTING OF ADAPTER PARAMETER CALCULATING SUBPROGRAM "Gamma".....40

APPENDIX III COMPLETE LISTING OF MEASUREMENT PROGRAM "ADP5M".....42

LIST OF ILLUSTRATIONS AND TABLES

PAGE

FIGURE 1 SIMPLIFIED BLOCK DIAGRAM X-BAND FRONT END AND RADIOMETER.....3

FIGURE 2 MEASUREMENT SETUP USING WAVEGUIDE TO COAX ADPT...5

FIGURE 3 MEASUREMENT SETUP FOR WAVEGUIDE TO COAX ADAPTER..6

FIGURE 4 FUNCTIONAL FLOW CHART FOR ADAPTER MEASUREMENT PROGRAM.....10

FIGURE 5 SAMPLE DATA LOG FOR USE WITH ADAPTER PROGRAM....12

FIGURE 6 SAMPLE PRINTOUT OF ADAPTER PARAMETERS SIX-PORT 1.....14

TABLE 1 IDEAL LENGTH FOR AIRLINES TO CALIBRATE DUAL SIXPORT WITH WAVEGUIDE INSERTION POINT.....17

TABLE 2 CONTENTS OF S MATRIX USED TO STORE ADAPTER EVALUATION RESULTS.....21

MEASUREMENT OF ADAPTER LOSS, MISMATCH, AND EFFICIENCY USING THE DUAL SIX-PORT

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A noise measurement system is being developed for the U. S. Air Force which uses coaxial cryogenic and ambient noise temperature standards to determine the noise temperature of the device under test. When the device under test has a different connector than those on the noise standards, an adapter has to be used. Adapter loss and complex reflection coefficients must be compensated for or noise measurement accuracy is affected. A technique has been developed which uses a dual six-port measurment system to determine the mismatch, loss, and ultimately the efficiency of the adapter used. This enables correction of measurement results and allows measurements to be made with an adapter with no degradation of accuracy.

This report describes this method of evaluating adapters and provides instructions for its use.

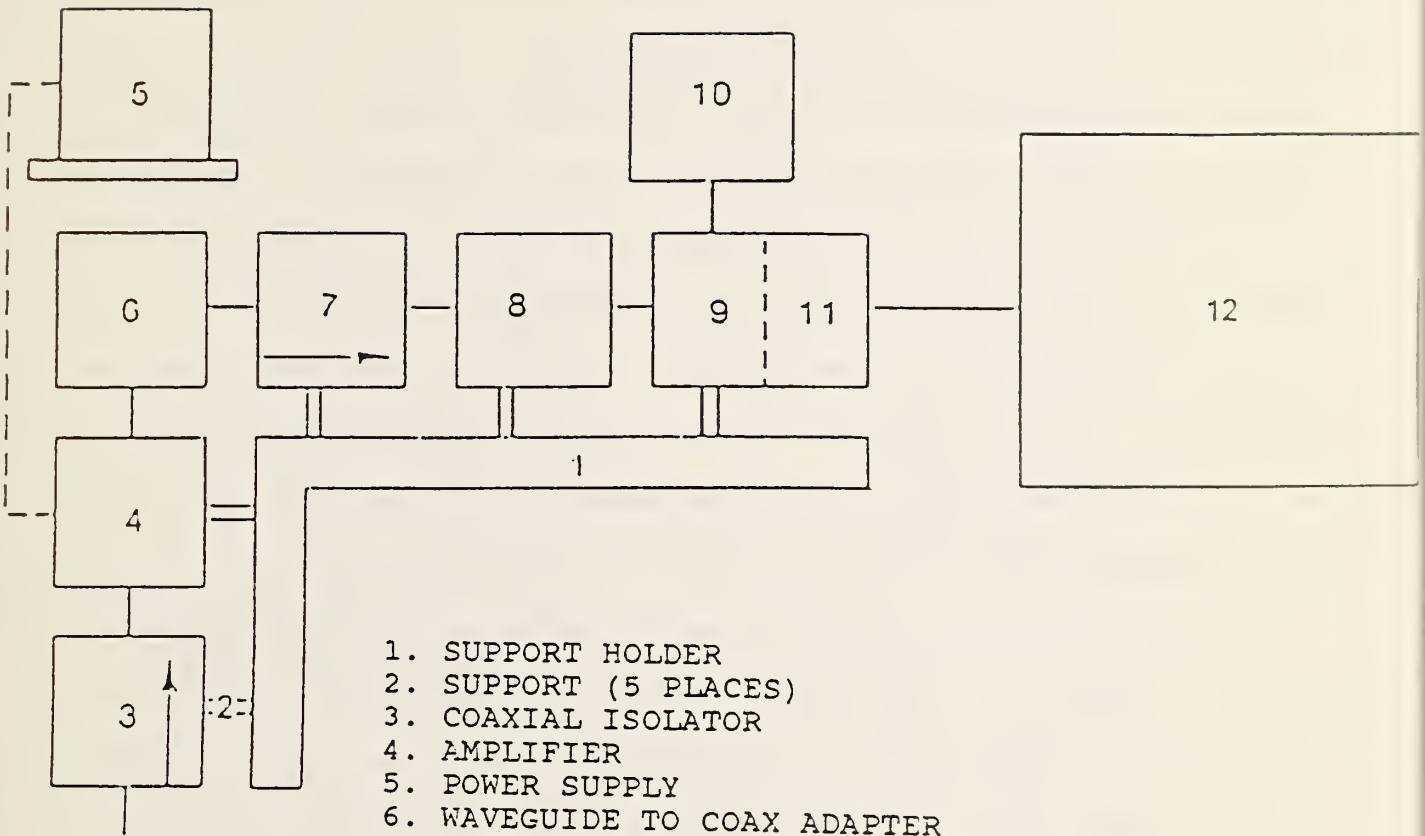
Key words: adapter parameters, dual six-port measurement system, efficiency, loss, measurement technique, mismatch.

I. INTRODUCTION

A noise measurement system is being developed at the Boulder Laboratories of the National Bureau of Standards for use by the Metrology Engineering Section at Newark Air Force Station. This system has accented the need for a reliable method of evaluating adapter input and output reflection coefficient, loss, and efficiency. A technique has been developed and tested which uses the dual six-port measurement system to ascertain these parameters. This technique requires calibrating the dual six-port system without adapters and then calibrating it again with adapters attached to the two measurement ports. Reflection coefficients and losses of the adapters on six-ports 1 and 2 are then calculated using the calibration results. After one further measurement which involves connecting the device under test to the adapter and determining the input reflection coefficient of this device, the efficiency of the combination can be calculated. If the device under test and adapter combination are left intact after this determination, an accurate correction for the the adapter can be made. In the following discussion, the adapter evaluation technique using the dual six-port measurement system is explained in simple terms. A detailed mathematical analysis of this technique is beyond the scope of this report. The main purpose of this report is to explain its function and use.

II. EQUIPMENT USED

The radiometer under developement is a complex multiband system. For simplicity, only the X-band front of this system is shown in Figure 1 which is a block diagram of this portion of the



1. SUPPORT HOLDER
2. SUPPORT (5 PLACES)
3. COAXIAL ISOLATOR
4. AMPLIFIER
5. POWER SUPPLY
6. WAVEGUIDE TO COAX ADAPTER
7. ISOLATOR
8. HARMONIC FILTER
9. MIXER
10. LOCAL OSCILLATOR
11. AMPLIFIER
12. RADIOMETER

SIMPLIFIED BLOCK DIAGRAM

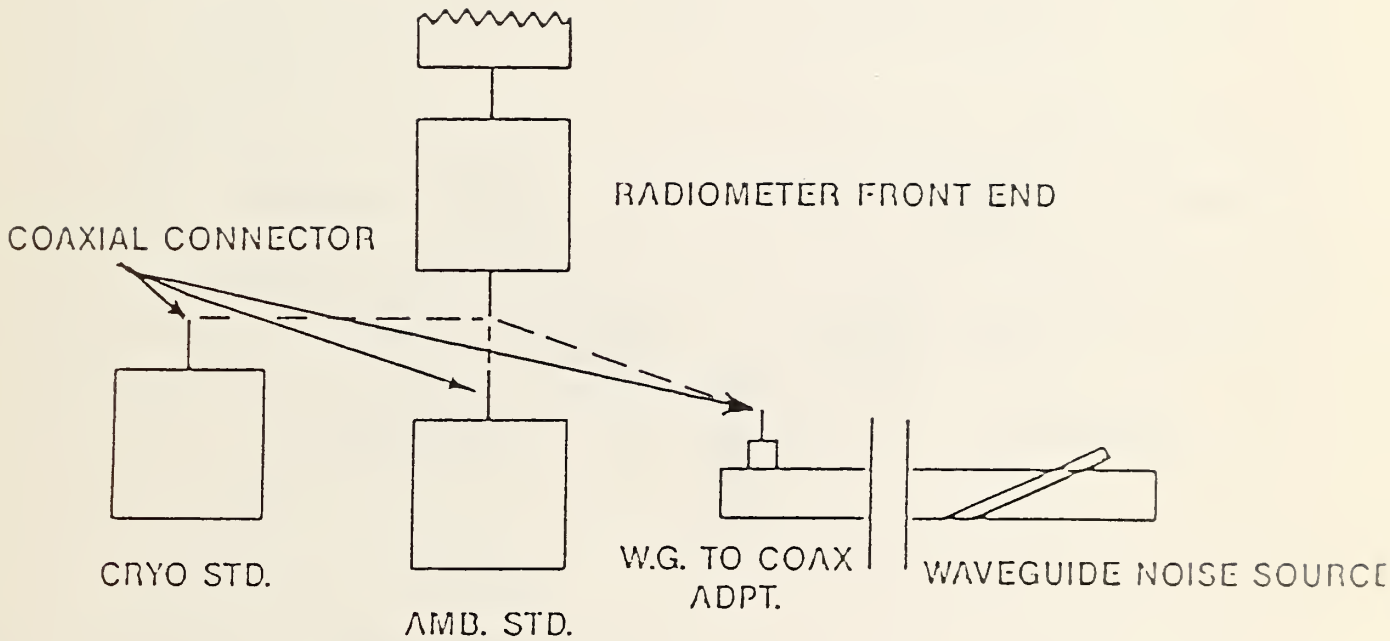
X BAND FRONT END AND RADIOMETER

FIGURE 1

radiometer. The insertion point of this portion of the system is coaxial, but by using the evaluation technique described above, the loss, reflection coefficient, and efficiency of an X-band waveguide to coax adapter could be determined and the system then used to calibrate waveguide noise sources. See figure 2 for a typical noise measurement setup. Note that the two standards are coaxial and that the device under test is waveguide. Since the complex reflection coefficients and loss of the waveguide to coax adapter can be determined, the measurement can be made with very little degradation in accuracy. In a similar fashion, correction can be made for coaxial adapters used to connect a device under test with a different connector type than the one on the standards.

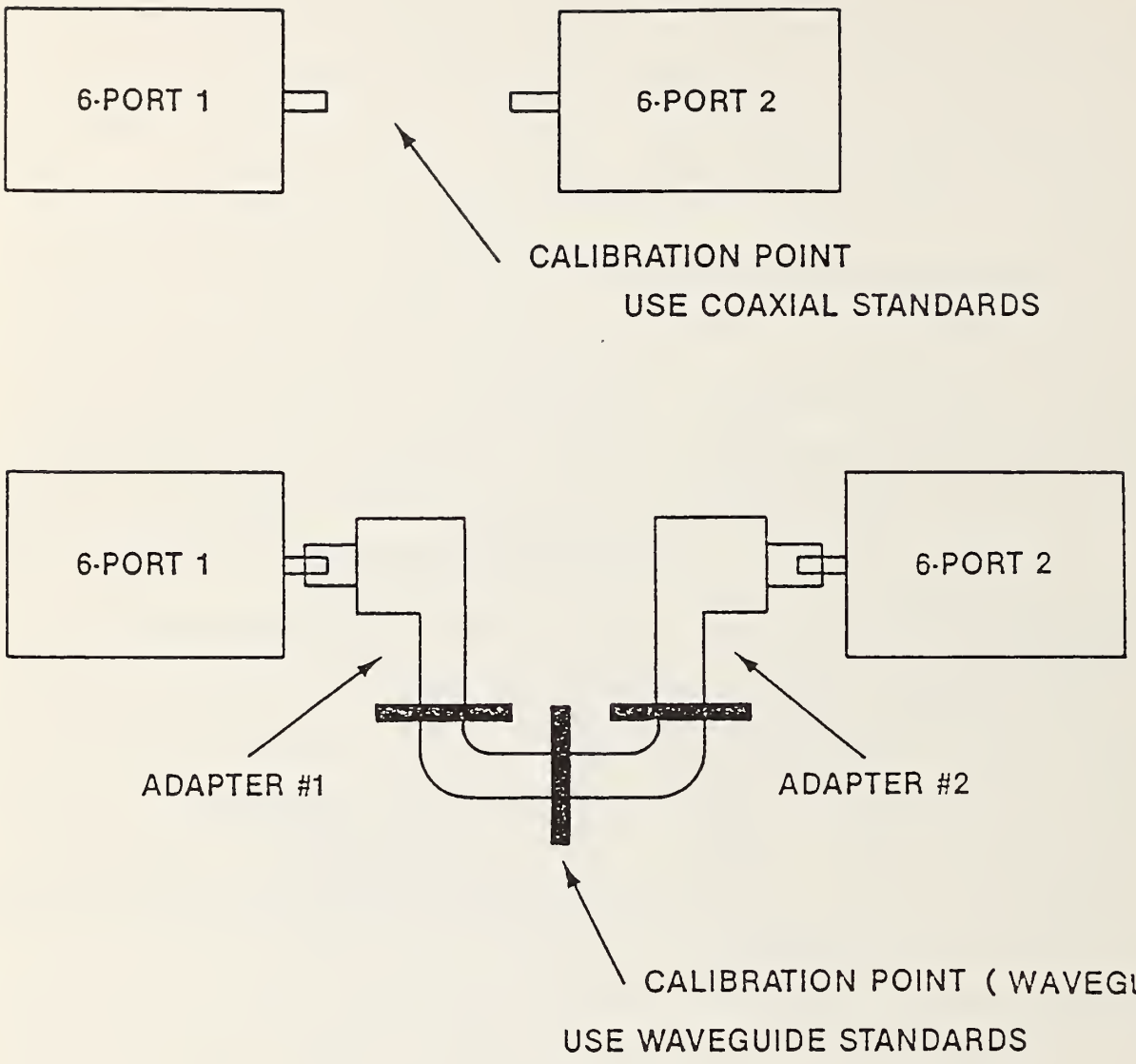
Figure 3 shows a typical setup for evaluating waveguide to coaxial adapters. The top portion of the figure shows the calibration system with no adapters while the bottom portion details the setup for measuring the loss and reflection coefficient of a waveguide to coax adapter. The two bends are used to eliminate any moding problems encountered when calibration standards are connected directly to the adapters. Short straight sections would do just as well but the bends were used to keep the insertion distance as short as possible and compensate for the right angle connections on the adapters.

The standards used to calibrate waveguide are the same as those used to calibrate coax except that in place of the open circuit calibration standards, quarter wave short circuits are used. These quarter wave short circuits need not be cut for the precise frequency of measurement. They should, however, be



MEASUREMENT SETUP USING WAVEGUIDE TO COAX ADAPT.

FIGURE 2



MEASUREMENT SETUP FOR WAVEGUIDE TO COAX ADAPTER

FIGURE 3

bolted in place when in use. Also the calibration airline is replaced by a waveguide straight section which ideally is of the length to cause a 90 degree phase shift. Table 1 (page 17) shows the ideal length for airlines at frequencies in the WR-284, WR-187, WR-137, and WR-90 waveguide sizes. The 90 degree column is the optimum length for a 90 degree airline. However, especially at higher frequencies, this length is shorter than practical. A workable airline can be achieved by adding to the 90 degree length, a length equivalent to 180 degrees until the desired length is obtained. The 180 degree column shows the length to add.

III. SOFTWARE

The software developed for adapter evaluation is modeled from a technique described by Glenn F. Engen in 1974 [1] and implemented by Ramon Jesch using an automatic network analyzer and power measurement system in 1977 [2].

The technique uses the following:

$$S11=(b'-b)/(a-b'c) \quad (1)$$

$$S22=(a'c-ac')/(a-b'c) \quad (2)$$

$$S12^2=(a'-bc')/(a-b'c) + S11S22 \quad (3)$$

where S11 and S22 are the complex reflection coefficients at each end of the adapter being measured and S12 is the transmission coefficient of the adapter from port 1 to port 2. The complex parameters a, b, and c are obtained by calibrating the six-ports without the adapters and a', b', and c'are obtained by calibrating the six-ports with the adapters in place. Figure 3 is a block diagram showing the measurement of a waveguide to coax adapter pair. The loss and reflection coefficient of each

adapter is obtained. a', b', and c' are not independent of a, b, and c. Some variables are obtained and stored during the calibration without the adapters and used to compute a', b', and c' with the adapters. These variables are computed in the "Iparab" and "Fparab" subprograms and are designated Zeta, Rho, W1, Re(W2), and IM(W2) in lines 5293 through 5298 of the adapter measurement program. The adapter measurement program is a modified version of the calibration program "CALBR". The modifications are mainly changes in program flow and include the addition of Subprograms "Gamma" and "FNAdp11". These subprograms provide for the calculation of scattering coefficients and efficiency of the adapters on the two six-ports by using the following in addition to (1), (2), and (3):

Alpha 120=S12m^2/(1-S11m^2) (4)

Alpha 210=S21m^2/(1-S22m^2) (5)

where S11m, S22m, S12m, and S21m are scattering coefficient magnitudes for the adapter determined by using (1), (2), and (3). Alpha 120 and Alpha 210 are loss coefficients for the adapter from port 1 to 2 and port 2 to 1 respectively. Input power times the loss coefficient equals the output power.

G1=S11 +(S12*S21*Gx)/(1-S22*Gx) (6)

where G1 is the calculated complex reflection coefficient of the device under test and adapter combination, and Gx is the complex input reflection coefficient of the device under test as measured from the adapter.

Alpha12=(1-Gxm^2)*S12m^2)/((1-G1m^2)*[1-S22Gx]^2) (7)

where Alpha 12 represents the efficiency of the device under test and adapter combination and Gxm, S12m, G1m, and [1-S22Gx] are

magnitudes of previously determined quantities. The quantity Alpha 12 is the correction factor for the adapter. Divide the measured noise temperature by this factor if the adapter is on the device under test; Multiply by this factor if the adapter is on the standard.

For convenience, listings of these subprograms are included in APPENDIX I of this report. The current version of the complete adapter measurement program has been named "ADPM5"

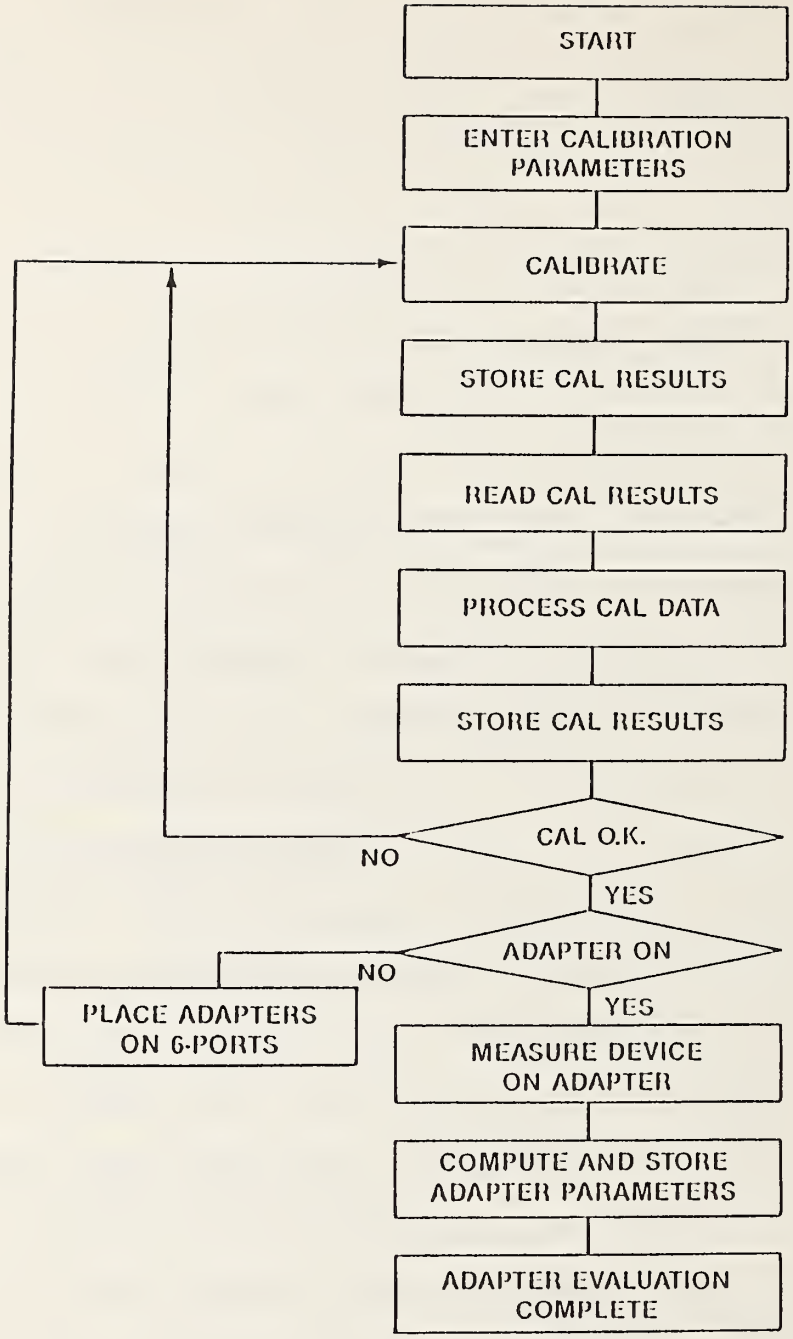
IV. MAKING A MEASUREMENT

A. GENERAL OVERVIEW OF THE MEASUREMENT PROCESS

The operator will find little difference between using this program and the software (PROGRAM "CALBR") furnished with the six-port measurement system. Program flow has been modified so that two calibrations are performed instead of one and a measurement of the device under test attached to the selected adapter is made. An additional store and print segment has been added to print adapter parameters and save them for use later.

A flow diagram describing the operation of program "ADPM5" is shown in Figure 4. As can be seen in the figure, calibration frequencies and other calibration parameters are input. Then, calibration of the dual six-port measurement system is performed first without the adapters under test, and then with the adapters. Finally, after the two calibrations, the device under test is attached to the desired adapter and measured. The power data obtained from the three operations is processed and the losses, reflection coefficients, and efficiencies of the adapters on both six ports are calculated and stored.

A log of data collected from calibration of the six-ports



FUNCTIONAL FLOW CHART
FOR
ADAPTER MEASUREMENT
PROGRAM

FIGURE 4

hould be maintained. Figure 5 is a sample data log showing the ata stored in one adapter evaluation. The program storage is rranged so that the files shown are overwritten if a new valuation is made. Permanent storage of calibration results is rovided in user named files if this is desired. The prompt: "DO OU WANT TO SAVE SYSTEM PARAMETER DATA ON MASS STORAGE--Y/N" is isplayed at the end of each calibration sequence. A yes answer s followed by prompts asking for file names desired and for a lisc to be placed in the correct disc drive. A no answer exits he routine and program execution continues.

3. DATA STORAGE AND USE

The first functions performed during program execution are calibrations of the six-ports with and without adapter. The results of the calibrations are stored in the power matrix files designated with a prefix of PWRH and PWRD. A number is added to this prefix to provide identification for the file. PWRH1 contains header information and describes the data file PWRD1 which contains the power data from the first calibration (without the adapters). After calibration, the power data is processed and file CRST1 is created. This file contains the results of the first calibration. The second calibration (with adapters) is now made and files PWRH2, PWRD2, and CRST2 are created and filled. After the calibrations, a device under test (usually a noise source with one output port is connected to the appropriate adapter and measured. Power data from this measurement is stored in file 1PRD3 which is described by header file 1PRH3. After the measurement of the device under test, Subprogram "Gamma" automatically accesses the correct files and computes, displays,

DATE	TIME	FREQ GHZ	DATA FILE NAMES	DESCRIPTION	CONN TYPE
850731	1722	3	PWRH1	SYSTEM CAL NO ADPT. HEADER INFO	N
			PWRD1	POWER MATRIX	
			CRST1	RESULT MATRIX	
850731	1744	3	PWRH2	ADAPTER ON SIX-PORT HEADER INFO	N
			PWRD2	POWER MATRIX	
			CRST2	RESULT MATRIX	
			1PRH3	D.U.T. ON ADPT. HEADER INFO(D.U.T.).	
			1PRD3	POWER MATRIX (D.U.T.)	
			CRST3	MODIFIED RESULT FOR ADPT.	
			AD-1	ALL ADAPTER SCATTERING PARAMETERS, LOSS, AND EFFICIENCY	

SAMPLE DATA LOG FOR USE WITH ADAPTER PROGRAM

FIGURE 5

and stores the reflection coefficients for the device under test--adapter combination. Subprogram "FNAdpt" then automatically retrieves data and calculates scattering coefficients, loss,and efficiency of the adapter. This data is stored in file AD-1 in the S matrix. A list of the contents of this matrix is found in Table 2 which is intended to be an aid in data retrieval. This data will be used to correct the noise temperature of the device under test for adapter error.

Figure 6 is a sample printout from the final phase of the program and details the loss and reflection coefficient of the adapters on both six-ports. The adapters used here were Type N male to female adapters.

C. RUNNING THE PROGRAM

Load "ADPM5" and press run.

As the program is run, prompts displayed on the screen lead the operator through required operations step by step.

1. The first prompt asks for the input option.

    1) Start, stop, and step list

    2) Type in list

    5) Exit

    Answer with the appropriate response (usually 1)

2. The second prompt asks:

    Input six-port option

    1) <=2GHZ 6-port

    2) >=2ghz 6-port

    Answer with the appropriate response.

3. The third prompt asks for frequency input as specified by options 1 or 2.

FILES PROCESSED=CRST5 AND CRST6

FREQUENCY= 7GHZ

ADAPTOR LOSS AT 6PORT NUMBER 1

SYSTEM CONSTANTS

A8,A9,B8,B9,C8,C9

A1,A2,B1,B2,C1,C2 .36931454192 .20671621467 .525670491353

-1.758488244E-02 -.250158691953 7.2367883E-02

ADAPTER CONSTANTS

A8,A9,B8,B9,C8,C9

-6.40256E-02 -.418296616 .53012308 4.721305E-02
-3.36437E-02 -.259555044

A1,A2,B1,B2,C1,C2 -6.402565E-02 -.41825661 .53012307
-4.721805E-02 -3.364376E-02 -.25955504

S12m,S12a,S12r,S12a

.98546034012 -68.400123 .36277018 -.9162586

IMPEDANCE DATA FOR ADAPTER PM SIX-PORT #1

S11 MAGNITUDE	S11 ANGLE	S11 REAL	S11 IMAGINARY
.1030	-119.84	-.0513	-.0893

S22 MAGNITUDE	S22 ANGLE	S22 REAL	S22 IMAGINARY
.1017	162.6897	-.0971	.0303

LOSS DATA FOR ADAPTER ON SIX-PORT 1

ALPHA 12	LOSS DB	ALPHA 21	LOSS DB
.9815	.0809	.9813	.0820

SAMPLE PRINTOUT OF ADAPTER PARAMETERS SIX-PORT 1

FIGURE 6

4. After the frequecies desired are entered, the fourth prompt asks:

Enter options for next operation

1) Input frequency

2) Determine system parameters without power standard

3) Measure 1-port on adapter

4) Evaluate Adapters

5) Exit

A response of 1 returns to the frequency input section of the program. A response of 2 is the normal input for a calibration sequence. A response of 3 is given only after both calibration have been performed . A response of 4 is given after both calibrations and the measurement of the one port device.

(This segment of the program is returned to after each task is accomplished and the program proceeds in response to the answers to the prompts).

5. The fifth prompt:

Turn on amplifiers Press continue when ready

6. The sixth prompt:

Enter connector type option

1) 14mm, 7mm, or waveguide

2) Type N male adapter on 6-port 1

3) Type N Female adapter on 6-port 1

4) Other, not available at present

Enter the desired response.

7. The seventh prompt asks for connection of shorts, opens, a measurement with system ports connected, a 2-port, and

airline with measurements being made on each device and the powers stored at the end of the sequence in a PWRD1 or PWRD2 file. After the first calibration, prompt 4 above is again displayed, and the program execution is repeated from that point until the two calibrations are completed.

When the second calibration is completed, prompt 4 is again displayed. This time answer with 3. This causes the program to access the measurement routines. Place the device under test on the appropriate adapter and continue program execution.

After the device under test is measured, prompt 4 is again displayed. This time answer the prompt with 4. This causes the program to automatically process the stored data and print and store the adapter evaluation data. When this has been accomplished, prompt 4 is again displayed. This time the correct response is 5. The beginning of the program is now accessed and measurements are complete. Press stop if no further measurements are desired.

The accuracy of the results obtained by this technique depends on a variety of factors. One way to evaluate systematic error is to perform the above tasks without inserting an adaptor. The varience of efficiency from unity is a measure of this error. This varience is usually less than .002.

TABLE 1

IDEAL LENGTH FOR AIRLINES TO CALIBRATE DUAL SIXPORT WITH WAVEGUIDE INSERTION POINT

WR-284 WAVEGUIDE

FREQUENCY GHZ	GUIDE WAVELENGTH INCHES	IDEAL AIRLINE INCHES	
		90 DEG	180 DEG
2.6	7.55	1.89	3.78
2.7	6.85	1.71	3.43
2.8	6.29	1.57	3.15
2.9	5.83	1.46	2.92
3.0	5.45	1.36	2.73
3.1	5.13	1.28	2.57
3.2	4.85	1.21	2.43
3.3	4.60	1.15	2.30
3.4	4.39	1.10	2.20
3.5	4.19	1.05	2.10
3.6	4.02	1.00	2.01
3.7	3.85	0.96	1.93
3.8	3.71	0.93	1.86
3.9	3.57	0.89	1.79
3.95	3.51	0.88	1.76

WR187 WAVEGUIDE

FREQUENCY GHZ	GUIDE WAVELENGTH INCHES	IDEAL AIRLINE INCHES	
		90 DEG	180 DEG
4.0	4.79	1.20	2.40
4.1	4.50	1.13	2.25
4.2	4.25	1.06	2.13
4.3	4.04	1.01	2.02
4.4	3.84	0.96	1.92
4.5	3.68	0.92	1.84
4.6	3.52	0.88	1.76
4.7	3.39	0.85	1.70
4.8	3.26	0.82	1.63
4.9	3.15	0.79	1.58

TABLE 1 (CONTINUED)

WR187 WAVEGUIDE (CONT)

FREQUENCY GHZ	GUIDE WAVELENGTH INCHES	IDEAL AIRLINE INCHES	
		90 DEG	180 DEG
5.0	3.04	0.76	1.52
5.1	2.94	0.74	1.47
5.2	2.85	0.71	1.43
5.3	2.77	0.69	1.39
5.4	2.69	0.67	1.35
5.5	2.62	0.65	1.31
5.6	2.55	0.64	1.28
5.7	2.49	0.62	1.25
5.8	2.42	0.61	1.21
5.85	2.39	0.60	1.20

WR137 WAVEGUIDE

FREQUENCY GHZ	GUIDE WAVELENGTH INCHES	IDEAL AIRLINE INCHES	
		90 DEG	180 DEG
5.9	2.92	0.73	1.46
6.0	2.82	0.71	1.41
6.1	2.73	0.68	1.36
6.2	2.64	0.66	1.32
6.3	2.56	0.64	1.28
6.4	2.49	0.62	1.25
6.5	2.42	0.61	1.21
6.6	2.36	0.59	1.18
6.7	2.30	0.57	1.15
6.8	2.24	0.56	1.12
6.9	2.19	0.55	1.09
7.0	2.14	0.53	1.07
7.1	2.09	0.52	1.04
7.2	2.04	0.51	1.02
7.3	2.00	0.50	1.00
7.4	1.96	0.49	0.98
7.5	1.92	0.48	0.96
7.6	1.88	0.47	0.94
7.7	1.85	0.46	0.92
7.8	1.81	0.45	0.91
7.9	1.78	0.45	0.89
8.0	1.75	0.44	0.87
8.1	1.72	0.43	0.86
8.2	1.69	0.42	0.85

TABLE 1 (CONTINUED)

WR90 WAVEGUIDE

FREQUENCY GHZ	GUIDE WAVELENGTH INCHES	IDEAL AIRLINE INCHES	
		90 DEG	180 DEG
8.2	2.40	0.60	1.20
8.3	2.32	0.58	1.16
8.4	2.25	0.56	1.12
8.5	2.18	0.55	1.09
8.6	2.12	0.53	1.06
8.7	2.06	0.52	1.03
8.8	2.01	0.50	1.01
8.9	1.96	0.49	0.98
9.0	1.91	0.48	0.96
9.1	1.87	0.47	0.94
9.2	1.83	0.46	0.91
9.3	1.79	0.45	0.89
9.4	1.75	0.44	0.88
9.5	1.72	0.43	0.86
9.6	1.68	0.42	0.84
9.7	1.65	0.41	0.83
9.8	1.62	0.41	0.81
9.9	1.59	0.40	0.80
10.0	1.56	0.39	0.78
10.1	1.54	0.38	0.77
10.2	1.51	0.38	0.76
10.3	1.49	0.37	0.74
10.4	1.46	0.37	0.73
10.5	1.44	0.36	0.72
10.6	1.42	0.35	0.71
10.7	1.40	0.35	0.70
10.8	1.38	0.34	0.69
10.9	1.36	0.34	0.68
11.0	1.34	0.33	0.67
11.1	1.32	0.33	0.66
11.2	1.30	0.32	0.65
11.3	1.28	0.32	0.64
11.4	1.27	0.32	0.63
11.5	1.25	0.31	0.62
11.6	1.23	0.31	0.62
11.7	1.22	0.30	0.61
11.8	1.20	0.30	0.60

TABLE 1 (CONTINUED)

WR90 WAVEGUIDE (CONT)			
FREQUENCY GHZ	GUIDE WAVELENGTH INCHES	IDEAL AIRLINE INCHES	
		90 DEG	180 DEG
11.9	1.19	0.30	0.59
12.0	1.17	0.29	0.59
12.1	1.16	0.29	0.58
12.2	1.15	0.29	0.57
12.3	1.13	0.28	0.57
12.4	1.12	0.28	0.56

TABLE 2

CONTENTS OF S MATRIX USED TO STORE ADAPTER EVALUATION RESULTS

MATRIX ELEMENT	DESCRIPTION
	ADAPTER ON SIX-PORT ONE
S(F,1)	S11 MAGNITUDE
S(F,2)	S11 PHASE
S(F,3)	S11 REAL PART
S(F,4)	S11 IMAGINARY PART
S(F,5)	ALPHA 12
S(F,6)	S22 MAGNITUDE
S(F,7)	S22 PHASE
S(F,8)	S22 REAL PART
S(F,9)	S22 IMAGINARY PART
S(F,10)	ALPHA 21
S(F,11)	S12 MAGNITUDE
S(F,12)	S21 MAGNITUDE
S(F,13)	REFL. COEFF. OF D.U.T. AND ADAPT.
S(F,14)	REFL. COEFF. ANGLE OF D.U.T. AND ADPT.
S(F,15)	REAL PART OF S(F,14)
S(F,16)	IMAGINARY PART OF S(F,14)
S(F,17)	EFFICIENCY OF ADAPTER
	ADAPTER ON SIX-PORT TWO
S(F,18)	S11 MAGNITUDE
S(F,19)	S11 PHASE
S(F,20)	S11 REAL PART
S(F,21)	S11 IMAGINARY PART
S(F,22)	ALPHA 12
S(F,23)	S22 MAGNITUDE
S(F,24)	S22 PHASE
S(F,25)	S22 REAL PART
S(F,26)	S22 IMAGINARY PART
S(F,27)	ALPHA 21
S(F,28)	S12 MAGNITUDE
S(F,29)	S21 MAGNITUDE
S(F,30)	REFL. COEF. OF D.U.T. AND ADPT.
S(F,31)	REFL. COEF. PHASE OF D.U.T. AND ADPT.
S(F,32)	REAL PART OF S(F,30)
S(F,33)	IMAGINARY PART OF S(F,30)
S(F,34)	EFFICIENCY OF ADAPTER

NOTE: THE F IN THE MATRIX IDENTIFIER REFERS TO THE FREQUENCY NUMBER.

V. REFERENCES

[1] Engen, Glenn F. Calibration Techniques for Automatic Network Analyzers with Application to Adapter Evaluation; IEEE Transactions on Microwave Theory and Techniques; Vol MT-22, No. 12; December 1974.

[2] Jesch Ramon C. Evaluation of Low-Loss/Low Reflection Two-Port Devices or Adapters by Automated Measurement Techniques; NBSIR 78-870; 1977.

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APPENDIX I

LISTING OF ADAPTER PARAMETER CALCULATING SUBPROGRAM "FNAdp"

```
6470 DEF FNAdp(Nfreqs,Repeats,M1,P1,M2,P2,CA$)
6480 !Calc Parameters for Adapter from 6-Port Measurements 850805
6490 OPTION BASE 1
6500 Msus$=":F8,1"
6510 DIM Result(Nfreqs,60),Freqs(Nfreqs),Id_content$[80],S(Nfreqs,34)
6521 K=0
6570 !LINPUT "ENTER FILE NAME FOR DATA WITHOUT ADAPTER";N1$
6580 FIXED 0
6590!LINPUT"ENTER FILE NAME FOR DATA WITH ADAPTER";N2$
6620 N1$="CRST1"
6630 N2$="CRST3
6640 CALL Redhed(N1$,Msus$,Date$,Time$,Typ$,Nfreqs,Freqs(*),
     Repeats, Sp, Std_mnt,Id_contents$,Cnnct$)
6650 MASS STORAGE IS ":F8,1"
6660 PRINTER IS 16
6670 PRINT "START OF FNADPT"
6680 Nfreq=N=Nfreqs
6690 PRINT
6700 PRINT
6710$Sport=1
6720 PRINTER MS 0
6721 PRINT
6724 PRINT "ADAPTER EVALUATION"
6725 PRINT"-----------------"
```

```
6727 PRINT
6730 PRINT "FILES PROCESSED=";N1$; " AND " ; N2$
6740 PRINT
6750 N1=INT(N1)
6760 N2=INT(N2)
6770 PRINTER IS 16
6780 FOR P=1 to Nfreqs
6790 FOR Prt=1 to 2
6800 PRINTER IS 16
6810 ON Prt GoTO 6820,6850
6820    CALL Redwrt(N2$,":F8,1"," ",Result(*),Nfreqs)
6830    Nfreq=1
6840 GOTO 6870
6850    CALL Redwrt(N2$,":F8,1"," ".Result(*),Nfreqs)
6860 NORMAL
6870 ON Sport GOTO 6880,6900
6880 Mc=0
6890 GoTo 6910
6900 Mc=12
6910 A8=Result(P,6+Mc)
6920 A9=Result(P,7+Mc)
6930 B8=Result(P,8+Mc)
6940 B9=Result(P,9+Mc)
6950 C8=Result(P,10+Mc)
6960 C9=Result(P,11+Mc)
6980 GOTO 6990
6990 A11(Prt)=A8
7000 A22 (Prt)=A9
```

```
7010 B11(Prt)=B8
7020 B22(Prt)=B9
7030 C11(Prt)=C8
7040 C22(Prt)=C9
7050 ON Prt GOTO 7060,7140
7060 FIXED 4
7061 PRINTER IS 16
7070 PRINT "FREQUENCY = ";Freqs(P);" GHZ"
7080 PRINT
7090 PRINT "ADAPTER LOSS AT 6PORT NUMBER ";Sport
7100 PRINT
7110 PRINT "SYSTEM CONSTANTS"
7120 PRINT
7130 GO TO 7180
7140 PRINT
7150 PRINTER IS 16
7160 PRINT "ADAPTER CONSTANTS"
7170 PRINT
7180 FIXED 4
7190 PRINT "A8,A9,B8,B9,C8,C9"
7200 PRINT A8,A9,B8,B9,C8,C9
7210 PRINT
7220 PRINT "A1,A2,B1,B2,C1,C1";A11(Prt),A22(Prt),B11(Prt),
     B22(Prt),C11(Prt),C22(Prt)
7230 PRINT
7240 NEXT Prt
7250 !
```

```
7260 ! S11=(b'-b)/(a-b'c)
7270 !
7280!_____________________________________________________________
7290 Z1=B11(2)
7300 Z2=B22(2)
7310 Z3=B11(1)
7320 Z4=B22(1)
7330 CALL Csua(Z1,Z2,Z3,Z4,Z9,Z0)
7340 Nr=Z9
7350 Ni=Z0
7360 Z3=C11(1)
7370 Z4=C22(1)
7380 CALL Cmua(Z1,Z2,Z3,Z4,Z9,Z0)
7390 Z3=Z9
7400 Z4=Z0
7410 Z1=A11(1)
7420 Z2=A22(1)
7430 CALL Csua(Z1,Z2,Z3,Z4,Z9,Z0)
7440 Z1=Nr
7450 Z2=Ni
7460 Z3=Z9
7470 Z4=Z0
7480 CALL Cdia(Z1,Z2,Z3,Z4,Z9,Z0)
7490 S11r=Z9
7500 S11i=Z0
7510 X=Z9
7520 Y=Z0
7530 CALL CRPA(X,Y,R,T)
```

```
7540 PRINT
7550 S11M=R
7560 S11a=T
7570!
7580! S22=(a'c-ac')/(a-b'c)
7590!
7600!_____
7610 Z1=A11(2)
7620 Z2=A22(2)
7630 Z3=C11(1)
7640 Z4=C22(1)
7650 CALL Cmua(Z1,Z2,Z3,Z4,Z9,Z0)
7660 Mr=Z9
7670 Mi=Z0
7680 Z1=A11(1)
7690 Z2=A22(1)
7700 Z3=C11(2)
7710 Z4=C22(2)
7720 CALL Cmua(Z1,Z2,Z3,Z4,Z9,Z0)
7730 Z1=Mr
7740 Z2=Mi
7750 Z3=Z9
7760 Z4=Z0
7770 CALL Csua(Z1,Z2,Z3,Z4,Z9,Z0)
7780 Mr=Z9
7790 Mi=Z0
7800 Z1=B11(2)
```

```
7810 Z2=B22(2)
7820 Z3=C11(1)
7830 Z4=C22(1)
7840 CALL Cmua(Z1,Z2,Z3,Z4,Z9,Z0)
7850 Z3=Z9
7860 Z4=Z0
7870 Z1=A11(1)
7880 Z2=A22(1)
7890 CALL Csua(Z1,Z2,Z3,Z4,Z9,Z0)
7900 Z3=Z9
7910 Z4=Z0
7920 Z1=Mr
7930 Z2=Mi
7940 CALL Cdia(Z1,Z2,Z3,Z4,Z9,Z0)
7950 S22r=Z9
7960 S22i=Z0
7970 X=Z9
7980 Y=Z0
7990 CALL Crpa(X,Y,R,T)
8000 S22M=R
8010 S22a=T
8020!
8030 !S12^2=(a'-bc')/(a-b'c)+S11*S22
8040 !
8050!_____
8060 Z3=C11(2)
8070 Z4=C22(2)
8080 Z1=B11(1)
```

```
8090 Z2=B22(1)
8100 CALL Cmua(Z1,Z2,Z3,Z4,Z9,Z0)
8110 Z1=A11(2)
8120 Z2=A22(2)
8130 Z3=Z9
8140 Z4=Z0
8150 CALL Csua(Z1,Z2,Z3,Z4,Z9,Z0)
8160 Mr=Z9
8170 Mi=Z0
8180 Z1=B11(2)
8190 Z2=B22(2)
8200 Z3=C11(1)
8210 Z4=C22(1)
8220 CALL Cmua(Z1,Z2,Z3,Z4,Z9,Z0)
8230 Z1=A11(1)
8240 Z2=A22(1)
8250 Z3=Z9
8260 Z4=Z0
8270 CALL Cmua(Z1,Z2,Z3,Z4,Z9,Z0)
8280 Z1=Mr
8290 Z2=Mi
8300 Z3=Z9
8310 Z4=Z0
8320 CALL Cdia(Z1,Z2,Z3,Z4,Z9,Z0)
8330 Mr=Z9
8340 Mi=Z0
8350 Z1=S11r
```

```
8360 Z2=S11i
8370 Z3=S22r
8380 Z4=S22i
8390 CALL Cmua(Z1,Z2,Z3,Z4,Z9,Z0)
8400 Z1=Z9
8410 Z2=Z0
8420 Z3=Mr
8430 Z4=Mi
8440 CALL Cada(Z1,Z2,Z3,Z4,Z9,Z0)
8450 Z1=Z9
8460 Z2=Z0
8470 CALL Csqra(Z1,Z2,Z9,Z0)
8480 S12r=Z9
8490 S12i=Z0
8500 S12m=SQR(Z9^2+Z0^2)
8510 S12a=ATN(S12i/S12r)*180/PI
8520 PRINT "S12m,S12a,S12r,S12i"
8530 PRINT S12m,S12a,S12r,S12i
8540 !
8550!*************************************************************
8560 !Alpha 210=(S21m)^2/(1-S22m^2)
8570 !Alpha 120=(S21m)^2/(1-S11m^2)
8580!*************************************************************
8590 A120=S12m^2/(1-S11m^2)
8600 A210=S12m^2/(1-S22m^2)
8610 Db120=10*LGT(A120)
8620 Db210=10*LGT(A210)
8630 PRINTER IS 16
```

```
8640 PRINT
8650 FIXED 0
8660 PRINTER IS 0
8680 PRINT
8690 PRINT "REFLECTION  COEFFICIENTS FOR  ADAPTER  ON  SIX-PORT #";Spor
8691 FIXED 2
8700 PRINT
8701 PRINT"FREQUENCY";Freqs(P);"GHZ"
8702 PRINT
8710 PRINT "S11 MAGNITUDE     S11 ANGLE      S11 REAL    S11
            IMAGINARY"
8720 PRINT "-------------     ----------     --------     -----
     ---------"
8730 FIXED 4
8740 PRINT S11m, S11a, S11r,S11i
8750 PRINT
8760 PRINT "S22 MAGNITUDE     S22 ANGLE      S22 REAL    S22
     IMAGINARY"
8770 PRINT "-------------     ----------     --------     -----
     ---------"
8780 PRINT S22m,S22a,S22r,S22i
8790 PRINT
8791 PRINT
8800 FIXED 0
8810 PRINT "LOSS DATA FOR ADAPTER ON SIX-PORT";SPORT
8820 PRINT "Alpha 12      LOSS DB      Alpha 21      LOSS DB"
8830 PRINT"---------      -------      --------      -------"
```

```
8840 FIXED 4
8860 PRINT A120,Db120,A210,Db210
8870 K=0
8880 PRINT
8900 NORMAL
8920 IF Sport =2 THEN K=17
8921 IF Sport=1 THEN K=0
8930 S(P,K+1)=S11m
8940 S(p,K+2)=S11a
8950 S(P,K+3)=S11r
8960 S(P,K+4)=S11i
8970 S(P,K+5)=A120
8980 S(P,K+6)=S22m
8990 S(P,K+7)=S22a
9000 S(P,K+8)=S22r
9010 S(P,K+9)=S22i
9020 S(P,K+10)=A120
9030 S(P,K+11)=S12m
9040 S(P,K+12)=S21m
9050!*****************************************************
9060 PRINTER IS 16
9070!  THE  FOLLOWING  CODE  EXISTS TO CALCULATE  EFFICIENCY  OF
        ADAPTER AND D.U.T.
9080!_____________________________________________________________
9090!
9100 !G1=S11+(S12*S21*Gx)/(1-S22*Gx)
9110 !
9111 ON Sport GOTO 9120 9132
```

```
9120 R=Gxm(Sport)=M1
9130 T=Gxa(Sport)=P1
9140 CALL Cpra(R,T,X,Y)
9150 Gxr(Sport)=X
9160 Gxi(Sport)=Y
9210 Z1=Z3=S12r
9220 Z2=Z4=S12i
9230 CALL Cmua(Z1,Z2,Z3,Z4,Z9,Z0)
9240 Z1=Z9
9250 Z2=Z0
9260 Z3=Gxr
9270 Z4=Gxi
9280 CALL Cmua(Z1,Z2,Z3,Z4,Z9,Z0)
9290 Nur=Z9
9300 Nui=Z0
9310 PRINT Nur, Nui,Z9,Z0
9320 Z1=S22r
9330 Z2=S22i
9340 Z3=Gxm(Sport)
9350 Z4=0
9360 CALL Cmua(Z1,Z2,Z3,Z4,Z9,Z0)
9370 PRINT "S22Gx"
9380 PRINT Z9,Z0
9390 Z1=1
9400 Z2=0
9410 Z3=Z9
9420 Z4=Z0
```

```
9430 CALL Csua(Z1,Z2,Z3,Z4,Z9,Z0)
9440 PRINT "1-S22GX",Z9,Z0
9450 Z1=Nur
9460 Z2=Nui
9470 Z3=Z9
9480 Z4=Z0
9490 Mag1=SQR(Z9^2+Z0^2)^2
9500 CALL Cdia(Z1,Z2,Z3,Z4,Z9,Z0)
9510 Z1=S21r
9520 Z2=S21i
9530 PRINT "S11R, S11I"; S11r,S11i
9550 Z3=Z9
9560 Z4=Z0
9570 CALL Cada(Z1,Z2,Z3,Z4,Z9,Z0)
9580 G1r=Z9
9590 G1i=Z0
9600!
9610!!_____________________________________________________________
9620! Alpha12=[(1-Gxm^2)*S12m^2]/[1-G1m^2*(1-S22Gx)m^2]
9630!
9660 Magn=(1-Gxm^2)*S12m^2)
9670 G1m=SQR(G1r^2+G1i^2)^2
9680 X=G1r
9690 Y=G1i
9700 CALL Crpa(X,Y,R,T)
9710 G1a=T
9720 Magd=(1-G1m)*Mag1
9730 Alpha12=Magn/Magd
```

```
9740 A12=Alpha12
9750 PRINTER IS 16
9760 PRINT "G1m, G1a, G1r, G1i"
9770 Print SQR(G1m),G1a,G1r,G1i
9780 PRINT "Gxm,Gxa,Gxr,Gxi"
9790 PRINT Gxm(Sport),Gxa(Sport),Gxr(Sport),Gxi(Sport)
9801 PRINTER IS 0
9805 PRINT "EFFICIENCY OF ADAPTER AND DEVICE COMBINATION";A12
9806 PRINT
9807 PRINT
9808 PRINTER IS 16
9810 IF Sport=1 then GOTO 9830
9920 GO TO 9900
9830 S(P,K+13)=Gxm(Sport)
9840 S(P,K+14)=Gxa(Sport)
9850 S(P,K+15)=Gxr(Sport)
9860 S(P,K+16)=Gxi(Sport)
9861 S(P,K+17)=A12
9890 GOTO 9940
9900 S(P,K+13)=Gxm(Sport)
9910 S(P,K+14)=Gxa(Sport)
9920 S(P,K+15)=Gxi(Sport)
9930 S(P,K+16)=Gxr(Sport)
9940 Sport=Sport+1
9950 if Sport=2 THEN GOTO 6790
9951 PRINT PAGE
9952 Sport=1
```

```
9955 NEXT P
9960 GOTO 9980
9970 PRINTER IS 16
9980 MASS STORAGE IS ":F8,1"
9990 FOR I=! TO 20
10000 NORMAL
10010 FIXED 0
10020 ASSIGN #1 TO "AD-"&VAL$(I),Check
10021 ASSIGN #1 TO *
10030 IF Check THEN Q$=VAL$(I)
10040 IF Check THEN 10060
10050 NEXT I
10060 CREATE "AD-"$Q$,2*Nfreqs
10070 ASSIGN #1 TO "AD-"&Q$
10080 PRINT #1;S(*)
10090 ASSIGN #1 TO *
10110 RETURN 0
10120 SUB Cmua(Z1,Z2,Z3,Z4,Z9,Z0)
10130 Z9=Z1*Z3-Z2*Z4
10140 Z0+Z1*Z4+Z2*Z3
10150 SUBEXIT
10160 SUBEND
10170 SUB Cdia(Z1,Z2,Z3,Z4,Z9,Z0)
10180 Z6=Z3^2+Z4^2
10190 Z9=(Z1*Z3+Z2*Z4)/Z6
10200 Z0=(Z2*Z3-Z1*Z4)/Z6
10210 SUBEXIT
10220 SUBEND
```

```
10230 SUB Cinva(Z1,Z2,Z3,Z4,Z9,Z0)
10240 Z6=Z1^2+Z2^2
10250 Z9=Z1/Z6
10260 Z0=Z2/Z6
10270 SUBEXIT
10280 SUBEND
10290 SUB Csqa(Z1,Z2,Z3,Z4,Z9,Z0)
10300 Z9=Z1*Z1-Z2*Z2
10310 Z0=2*Z1*Z2
10320 SUBEXIT
10330 SUBEND
10340 SUB Cada(Z1,Z2,Z3,Z4,Z9,Z0)
10350 Z9=Z1+Z3
10360 Z0=Z2+Z4
10370 SUBEXIT
10380 SUBEND
10390 SUB Csua(Z1,Z2,Z3,Z4,Z9,Z0)
10400 Z9=Z1-Z3
10410 Z0=Z2-Z4
10420 SUBEXIT
10430 SUBEND
10440 SUB Caba(Z1,Z2,Z9)
10450 Z9=SQR(Z1*Z1=Z2*Z2)
10460 SUBEXIT
10470 SUBEND
10480 SUB Csqra(Z1,Z2,Z9,Z0)
10490 X=Z1
```

```
10500 Y=Z2
10510 CALL Crpa(X,Y,R,T)
10520 R=SQR(R)
10530 T=T/2
10540 Z9=R*COS(PI*T/180)
10550 Z0=R*SIN(PI*T/180)
10560 GOTO 12570
10570 SUBEXIT
10580 SUBEND
10590 SUB Crpa(X,Y,R,T)
10600 R=SQR(X^2+Y^)
10610 IF X=0 THEN GO TO 10640
10620 T=ATN(Y/X)
10630 GO TO 10650
10640 T=PI*SGN(Y)/2
10650 T=T*180/PI
10660 IF X>=0 THEN 10710
10670 IF Y>=0 THEN 10700
10680 T=T-180
10690 GO TO 10710
10700 T=T+180
10710 SUBEXIT
10720 SUBEND
10730 SUB cmuada(Z1,Z2,Z3,Z4,Z5,Z6,Z7,Z8,Z9,Z0)
10740 Z9=Z1*Z3-Z2*Z4+Z5*Z7-Z6*Z8)
10750 Z0=Z1*Z4-Z2*Z3+Z5*Z8+Z6*Z7)
10760 SUBEXIT
10770 SUBEND
```

```
10780 SUB Cpra(R,T,X,Y)
10790 X=R8COS(PI*T/180)
10800 Y=R*SIN(PI*T/180)
10810 SUBEXIT
10820 SUBEND
```

APPENDIX II

LISTING OF ADAPTER PARAMETER CALCULATING SUBPROGRAM "Gamma"

```
11300 SUB Gamma(Nfreqs,Repeats,Ca$)
11310 OPTION BASE 1
11320 DIM Power(Nfreqs,Repeats,16,10),Po(1,8),Result(Nfreqs,60)
      Wrspt(2,12)
11330 FREAD "1PRD&"3"&":F8,1",Power(*)
11340 G=1
11350 PRINTER IS 16
11360 File$="CRST"&"2"
11370 FOR F=1 TO Nfreqs
11380 CALL Redwrt(File$,"F8,1"," ",Result(*),Nfreqs)
11390 FOR J=1 TO 2
11400 FOR N=1 TO 12
11410 PRINTER IS 0
11420 Wrspt(J,N)=Result(F,N+(J-1)*12)
11430 NEXT N
11440 NEXT J
11480 FOR Mnt=1 to 8
11490 Po(1,Mnt+Inc)=Power(F,1,1,Mnt+Inc)
11500 NEXT Mnt
11520 CALL Mg(Po(*),1,1,Wrspt(*),"P",M1,P1,R1)
11530 CALL Mg(Po(*),1,1,Wrspt(*),"P",M1,P1,R2)
11540 PRINTER IS 0
11550 PRINT "FREQ#",F
11552 PRINT
```

```
11554 PRINT "DEVICE PLUS ADAPTER ON 6-PORT 1"
11555 PRINT
11560 PRINT "GAMMA MAGNITUDE","GAMMA PHASE"
11561 PRINT "---------------","-----------"
11562 PRINT USING 11585;M1,P1
11563 PRINT
11564 PRINT "DEVICE PLUS ADAPTER ON 6-PORT 2"
11565 PRINT
11567 PRINT "GAMMA MAGNITUDE","GAMMA PHASE"
11568 PRINT "---------------","-----------"
11570 PRINT USING 11585;M2,P2
11585 IMAGE MD.DDDDD,12X,MDDD.DDDD
11590 NEXT F
11591 NORMAL
11592 PRINT
11593 PRINT
11594 PRINT
11595 PRINTER IS 16
11600 Q=FNAdp(Nfreqs,Repeats,M1,P1,M2,P2,Ca$)
11610 SUBEXIT
11620 SUBEND
```

APPENDIX III

COMPLETE LISTING OF MEASUREMENT PROGRAM "ADP5M"

```
880519
ADP5M

3 ! ****** ADP5M ******
4 ! RE-STORE "ADP5M:F8"  !AUGUST 28, 1985 1020
6 ! FILE NAME:   ADPTR5 !850828 0804 BCY-GJC
    ORIG VS IS CALBR40205-1000---BCY
7 ! ADP11 INSERTED AT LINE 9000 THIS VERSION
9   OPTION BASE 1
12  DIM F_list(11),Path(11),Amps(5),Line(11),Fstop_a(11),Famps(6)
13  DIM Typ$[6],Fil_nam$[6],Linput$[160],Mntno(10)
14 ! CALL Doc
22  PRINTER IS 16
23  DISP " "
24  Max_pts=11
27  Nfreqs=0
28  G1=0
30  Typ=1
31  Cal=1
33  ON ERROR GOTO Off
36  Tape$="14"
39  MASS STORAGE IS ":T"&Tape$
40  MASS STORAGE IS ":F8,1"
42  Print$="0"
45  OFF ERROR
48  GOTO Freq
51  Off: OFF ERROR
54  Print$="7,1"
57  GOTO Freq
60  Task:    PRINT  CHR$(12);LIN(5);TAB(10);CHR$(7);"ENTER  OPTION
            NUMBER FOR NEXT OPERATION:"
61   IF Proc<0 THEN INPUT "NUMBER OF FREQUENCIES TO PROCESS AND
    NUMBER OF Repeats",Nfreqs,Repeats
63  GOSUB Menu
66  Opt:  LINPUT "OPTION NUMBER ? ",Linput$
69        IF NOT FNNumi(Linput$) THEN Opt
72        Typ=VAL(Linput$)
75        IF (Typ<0) OR (Typ>5) THEN Opt
76        IF Typ>2 THEN Typ=Typ+1
78        IF Typ>5 THEN End
79        IF Proc=-1 THEN Proc=0
80        IF Typ=5 THEN CALL Gamma(Nfreqs,Repeats,Ca$)
81        IF Typ=5 THEN GOTO 22
83  Freq:IF Typ=1 THEN CALL Freqin(Max_pts,Nfreqs,Hi_lo_port,
          F_list(*),Path(*),Amps(*),Line(*),Lines,Fstop_a(*),
          Famps(*),Proc)
```

```
84        IF Typ>1 THEN Typ
87  GOTO Task
90  Typ:  PRINT CHR$(7);LIN(5);TAB(10);"TURN ON AMPLIFIER(S):"
93        FOR I=1 TO 5
96        IF Amps(I) THEN PRINT TAB(15);Famps(I);"-";Famps(I+1)
99        NEXT I
102       PRINT LIN(2);TAB(10);"PRESS 'CONT' WHEN READY"
105       PAUSE
108       Dim=16*(Typ<3)+4*(Typ=3)+(Typ>3)+(Typ=5)
111       IF Typ=1 THEN Typ$="FREQ"
114       IF Typ=2 THEN Typ$="PRTCAL"
115       IF Typ=4 THEN Typ$="1_PORT"
117   Cnnct:  PRINT  CHR$(7);CHR$(12);LIN(5);TAB(10);"ENTER
              CONNECTOR TYPE OPTION:"
118   IF Cal=4 THEN Cal=VAL(Ca$)
119   PRINT
120   IF (Cal=2) AND (Typ=4) THEN PRINT "                CONNECT
         ADAPTER AND 1 PORT DEVICE";CHR$(7)
121   IF (Cal=2) AND (Typ<4) THEN PRINT "         CONNECT ADAPTER "
         ;CHR$(7)
122   PRINT
123   GOSUB Menu1
124   LINPUT "ENTER OPTION NUMBER ",Linput$
126   IF NOT FNNumi(Linput$) THEN Cnnct
129   Cnnct=VAL(Linput$)
132   IF (Cnnct<1) OR (Cnnct>3) THEN Cnnct
135   IF Cnnct=1 THEN Cnnct$="NOT N"
138   IF Cnnct=2 THEN Cnnct$="TN_2L"
141   IF Cnnct=3 THEN Cnnct$="TN_2R"
144   IF Cnnct=4 THEN Cnnct$="WGN"
147   Rep2:  PRINT CHR$(12);CHR$(7)
150 ! LINPUT "ENTER # OF REPEAT MEASUREMENTS (SIDE-ARM SCANS)
       -- (1-10) ",Linput$
151   Linput$="1"
153   Tst:    IF NOT FNNumi(Linput$) THEN Rep2
156   Repeats=VAL(Linput$)
159   IF (Repeats<1) OR (Repeats>10) THEN Rep2
162   IF (Repeats>3) AND (Typ<3) THEN Rep2
163 !IF (Proc=1) AND (Typ=4) THEN GOTO Gamma1
164   IF Proc>0 THEN GOTO 171
165   Cal: DISP
168   CALL Caldat(Max_pts,Nfreqs,Repeats,Dim,Hi_lo_port,
          F_list(*),Typ$,S_port,Std_mnt,Print$,Path(*),Line(*),
          Lines,Fstop_a(*),Cnnct$,Mounts,Mntno(*),Cal)
169   IF Typ=4 THEN GOTO 225
171   CALL Calres(Max_pts,Nfreqs,Repeats,Dim,Typ$,S_port,
          Std_mnt,Hi_lo_port,Print$,Cal,G1,Ca$)
174   DISP " "
177   DISP "DO YOU WANT TO SAVE SYSTEM PARAMETER DATA ON
           MASS STORAGE ?";CH$(7)
178   Flag=FNYorn
180   IF NOT Flag THEN GOTO Jump225
183   DISP " "
186   DISP "INSERT USER DISC INTO MASS STORAGE F8,0
           --- PRESS 'CONT' WHEN READY";CHR$(7)
```

```
189  PAUSE
192  File:  DISP " ";CHR$(7)
195  LINPUT "ENTER USER FILE NAME --- LESS THAN 7
           CHARACTERS",Fil_nam$
198  IF LEN(Fil_nam$)>6 THEN DISP "FILE NAME IS TOO
     LONG";CHR$(7);
201  IF LEN(Fil_nam$)>6 THEN File
204  ASSIGN #1 TO Fil_nam$&":F8,0",Check
207  ASSIGN * TO #1
210  IF Check THEN Disc
213  DISP " "
216  DISP "FILE NAME ";Fil_nam$;" IS IN USE.
         CONTINUE -- (Y/N) ?";CHR$(7);
219  IF FNYorn THEN Flag=1
220  IF Flag THEN PURGE Fil_nam$&":F8,0"
221  IF Flag THEN Disc
222  GOTO File
223  IF G1=1 THEN Ca$="3"
224  Disc:  CALL Disc_copy(Fil_nam$,Nfreqs,Typ$,Ca$)
225  Ca$=VAL$(Cal)
226  Jump225: IF Cal=4 THEN GOTO Cnnct
228  IF Cal=1 THEN GOTO 237   !!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
230  IF Cal=3 THEN Task              !Gamma(Nfreqs,Repeats,Ca$)
231  GOTO 22
234  GOTO Task
235  Cal=1
236  GOTO Task
237  Cal=2
238  GOTO Cnnct
239  Menu: IF Proc<0 THEN CALL Gamma(Nfreqs,Repeats,Ca$)
240  IF Proc<0 THEN GOTO 48
243  PRINT USING Form1
244  PRINT USING Form2
245  RETURN
246  Menu1: PRINT USING Form3
249  PRINT USING Form4
252  RETURN
255  Form1: IMAGE /10X"1) INPUT FREQUENCIES"/10X"2)
           DETERMINE SYSTEM PARAMETERS WITHOUT POWER
           STANDARD"
258  Form2: IMAGE 10X"3) MEASURE 1-PORT ON ADAPTER"/10X"4)
           EVALUATE ADAPTERS"/10X"5) EXIT"
261  Form3: IMAGE /10X"1) 14mm, 7mm,OR WAVEGUIDE"/10X"2)
           TYPE N, MALE ADAPTER ON 6-PORT #1"/10X"3) TYPE N,
           MALE ADAPTER ON 6-PORT #2"
264  Form4: IMAGE 10X"4) OTHER, NOT AVAILABLE AT PRESENT"
267  End:   DISP "MEASUREMENT SESSION DONE"
268         PRINT CHR$(12)
270  Gamma1:PRINT "THIS IS Gamma"! THIS SEGMENT MUST CALL DATA
            FILES NEEDED
271  PAUSE
272  CALL Caldat(Max_pts,Nfreqs,Repeats,Dim,Hi_lo_port,F_list(*),
       Typ$,S_port,Std_mnt,Print$,Path(*),Line(*),Lines,
       Fstop_a(*),Cnnct$,Mounts,Mntno(*),Cal)
273  CALL Gamma(Nfreqs)
```

```
274  Q=FNAdp(Nfreqs)
275  GOTO 235
276  END
279 ! FILE NAME:   FREQIN                    ! 800610-1615---BCY
```

MAIN

Amps(	12	83	96				
Ca$	80	118	171	223	224	225	239
Ca$:	0	223					
Cal	31	118	118	120	121	168	171
	225	226	228	230	235	237	272
Cal:	165						
Check	204	210					
Cnnct	129	132	132	135	138	141	144
Cnnct$	0	135	138	141	144	168	272
Cnnct$:	0	135	138	141	144		
Cnnct:	117	126	132	226	238		
Dim	108	168	171	272			
Disc:	224	210	221				
End:	267	78					
F_list(	12	83	168	272			
Famps(	12	83	96	96			
Fil_nam$	13	195	198	201	204	216	220
	224						
File:	192	201	222				
Flag	178	180	219	220	221		
Form1:	255						
Form2:	258						
Form3:	261						
Form4:	264						
Freq:	83	48	57				

Fstop_a(12 83 168 272

G1 28 171 223

Gamma1: 270

Hi_lo_port 83 168 171 272

I 93 96 96 96 99

Jump225: 226 180

Line(12 83 168 272

Lines 83 168 272

Linput$ 13 66 69 72 124 126 129
151 153 156

Max_pts 24 83 168 171 272

Menu1: 246 123

Menu: 239 63

Mntno(13 168 272

Mounts 168 272

Nfreqs 27 61 80 83 168 171 224
239 272 273 274

Off: 51 33

Opt: 66 69 75

Path(12 83 168 272

Print$ 42 54 168 171 272

Proc 61 79 79 83 164 239 240

Q 274

Rep2: 147 153 159 162

Repeats 61 80 156 159 159 162 168
171 239 272

S_port 168 171 272

Std_mnt 168 171 272

Tape$ 36 39

Task:	60	87	230	234	236		
Tst:	153						
Typ	30	72	75	75	76	76	76
	78	80	81	83	84	108	108
	108	108	111	114	115	120	121
	162	169					
Typ$	13	111	114	115	168	171	224
	272						
Typ$:	0	111	114	115			
Typ:	90	84					

```
282  SUB Freqin(Max_pts,Nfreqs,Hi_lo_port,F_list(*),Path(*),
         Amps(*),Line(*),Lines,Fstop_a(*),Famps(*),Proc)
285  OPTION BASE 1
288  PRINTER IS 16
291  PRINT CHR$(12)
294  DISP " "
297  Famps(1)=.25
300  Famps(2)=1
303  Famps(3)=2
306  Famps(4)=4
309  Famps(5)=8
312  Famps(6)=18
315  CALL Freq(Max_pts,Nfreqs,Hi_lo_port,F_list(*),Path(*),Amps(*),
          Line(*),Lines,Fstop_a(*),Bail$,Proc)
318  PRINT CHR$(12)
321  DISP " "
324  SUBEND
327 ! *************** SUBPROGRAM FREQ ************************
330 ! FILE NAME:  FREQ                      ! 811216-1715---BCY

S Freqin(


Amps(              282    315

Bail$              315

F_list(            282    315

Famps(             282    297    300    303    306    309    312

Fstop_a(           282    315

Hi_lo_port         282    315

Line(              282    315

Lines              282    315

Max_pts            282    315

Nfreqs             282    315

Path(              282    315

Proc               282    315
```

```
333  SUB Freq(Max_pts,Nfreqs,Hi_lo_port,F_list(*),Path(*),Amps(*),
         Line(*),Lines,Fstop_a(*),Bail$,Proc)
336  OPTION BASE 1
339  DIM A$[32],Linput$[160]
342    A$="FREQUENCY INPUT/OUTPUT SECTION"
345    Center=(80-LEN(TRIM$(A$)))/2
348    PRINT TAB(Center),A$,LIN(2);CHR$(7)
351    PRINT "MAXIMUM # OF FREQUENCIES =";Max_pts
354 ! -------------- INPUT OPTIONS --------------------------
357  P_opt1:    PRINT USING Form1;CHR$(7)
360             LINPUT "INPUT OPTION # ",Linput$
361             IF Linput$="5" THEN GOTO 428
363             IF NOT FNNumi(Linput$) THEN P_opt1
366             Opt=VAL(Linput$)
367             IF VAL(Linput$)=3 THEN Proc=1
368             IF VAL(Linput$)=4 THEN Proc=-1
369             IF Proc<0 THEN GOTO 431
370             Opt=1
371          IF (Opt<=0) OR (Opt>2) THEN P_opt1
373  P_opt2:    PRINT USING Form2;CHR$(7)
375             LINPUT "INPUT 6-PORT OPTION # ",Linput$
378             IF NOT FNNumi(Linput$) THEN P_opt2
381             S_opt=VAL(Linput$)
384          IF (S_opt<=0) OR (S_opt>2) THEN P_opt2
387             Hi_lo_port=S_opt-1
390             PRINT CHR$(12)
393  Opt:    Bail$="N"
396          Flag=0
399          ON Opt GOSUB Sss,Type
402        IF Bail$="Y" THEN GOSUB Restart
405        IF Flag THEN Opt
408        IF NOT Flag AND (Bail$="Y") THEN Exit
411 ! --------- PROCESS DATA, WHICH AIR LINE, AMPLIFIER -------
414  Round:    I=I+1
417           F_list(I)=PROUND(F_list(I),-6)
420           IF I<Nfreqs THEN Round
423           CALL Aline(Hi_lo_port,Nfreqs,F_list(*),Line(*),Lines,
                   Fstop_a(*))
426           CALL Path(Hi_lo_port,Nfreqs,F_list(*),Amps(*),Path(*))
427  GOTO 431
428  PRINT "END OF SESSION"
429  STOP
431  Exit: SUBEXIT
432 ! ---------------- START, STOP, STEP ----------------------
435  Sss:  CALL F_step(Opt,Hi_lo_port,Max_pts,Nfreqs,F_list(*),
             Bail$,Proc)
438  RETURN
441 ! ------------------ TYPE IN LIST -------------------------
444  Type:  CALL F_type(Opt,Hi_lo_port,Max_pts,Nfreqs,F_list(*),
              Bail$,Proc)
447  RETURN
450 ! ------------------ RESTART ------------------------------
453  Restart:  DISP "RESTART SAME OPTION ?--(Y/N)";CHR$(7);! retry
                 same option ?
456          IF FNYorn THEN Flag=1
```

```
459  RETURN
462 ! -------------- IMAGE FORMATS ----------------------------
465  Form1:  IMAGE /"OPTIONS:"//"1. START,STOP,STEP LIST"/"2.
                  TYPE IN LIST",K!/"3. PROCESS DATA FOR ADAPT
                  LOSS"/" 4. CALCULATE ADAPTER LOSS"/"5. EXIT"
                  /,K
468  Form2:  IMAGE /"INPUT 6-PORT OPTION:"/"1) <=2GHz 6-PORT"/"2)
                   >=2 GHz 6-PORT"/,K
471  SUBEND
474  ! ************** SUBPROGRAM ALINE ***********************
477  !  FILE NAME:   ALINE                  ! 811216-1600---BCY
```

S Freq(

A$	339	342	345	348			
Amps(	333	426					
Bail$	333	393	402	408	435	444	
Center	345	348					
Exit:	431	408					
F_list(	333	417	417	423	426	435	444
Flag	396	405	408	456			
Form1:	465						
Form2:	468						
Fstop_a(	333	423					
Hi_lo_port	333	387	423	426	435	444	
I	414	414	417	417	420		
Line(	333	423					
Lines	333	423					
Linput$	339	360	361	363	366	367	368
	375	378	381				
Max_pts	333	351	435	444			
Nfreqs	333	420	423	426	435	444	
Opt	366	370	371	371	399	435	444
Opt:	393	405					
P_opt1:	357	363	371				

P_opt2: 373 378 384

Path(333 426

Proc 333 367 368 369 435 444

Restart: 453 402

Round: 414 420

S_opt 381 384 384 387

Sss: 435 399

Type: 444 399

```
480  SUB Aline(Hi_lo_port,Nfreqs,F_list(*),Line(*),Lines,Fstop_a(*))
483  OPTION BASE 1
486  DIM F(7,Nfreqs)
489  Aline(1)=15     ! .25--<.75 GHz
492  Aline(2)=5      ! .75--2 GHz
495  Aline(3)=3      ! 2--3.75, 6.25--8.75, 11.25--13.75,
                      16.25--18 GHz
498  Aline(4)=5      ! >3.75--5.25, 9.75--<13.75 GHz
501  Aline(5)=6      ! 5.625--<6.25, >13.75--14.375,
                      15.625--<16.25 GHz
504  Aline(6)=7.5    !>8.75--9.375, 14.5--15.5 GHz
507  Aline(7)=10     !>5.25--<5.625, >9.375--<9.75, >15.5
                       --<15.625 GHz
510     Start=J=(Hi_lo_port=1)*2
513     Stop=2+(Hi_lo_port=1)*5
516     Hi_lo=Hi_lo_port+1
519  Inc_i:    I=I+1  !------------ BEGIN LINE SORT -------------
522            X=F_list(I)
525            K=0
528            ON Hi_lo GOSUB Lo,Hi
531            Cntr(K)=Cntr(K)+1
534            F(K,I)=X
537            IF I<Nfreqs THEN Inc_i
540  Inc_j:    J=J+1
543            IF J>Stop THEN SUBEXIT
546            IF Cntr(J)=0 THEN Inc_j
549            L=0
552  Inc_l:    L=L+1
555            IF L>Nfreqs THEN Inc_j
558            IF F(J,L)=0 THEN Inc_l
561            N=N+1
564            F_list(N)=F(J,L)
567            Fstop_a(N)=Cntr(J)
570            Cnt=Aline(J)
573            Line(N)=Cnt
576            IF Cnt<>Last_cnt THEN Lines=Lines+1
579            Last_cnt=Cnt
582  GOTO Inc_l
585  Lo:    K=1
588         IF X>=.75 THEN K=2
591  RETURN
594  Hi:  IF (X>=2) AND (X<=3.75) OR (X>=6.25) AND (X<=8.75) OR
         (X>=11.25) AND (X<=13.75) OR (X>=16.25) AND (X<=18) THEN
         K=3
597       IF K THEN RETURN
600       IF (X>3.75) AND (X<=5.25) OR (X>=9.75) AND (X<13.75) THEN K=4
603       IF K THEN RETURN
606       IF (X>=5.625) AND (X<6.25) OR (X>13.75) AND (X<=14.375)
          OR (X>=15.625) AND (X<16.25) THEN K=5
609       IF K THEN RETURN
612       IF (X>8.75) AND (X<=9.375) OR (X>=14.5) AND (X<=15.5)
          THEN K=6
615       IF K THEN RETURN
618       K=7
621  RETURN
```

```
624  SUBEND
627  ! ************* SUBPROGRAM F_STEP ************************
630  ! FILE NAME: F_STEP                    ! 811216-0830---BCY

S Aline(
```

Aline(	489	492	495	498	501	504	507
	570						
Cnt	570	573	576	579			
Cntr(	531	531	546	567			
F(	486	534	558	564			
F_list(	480	522	564				
Fstop_a(	480	567					
Hi:	594	528					
Hi_lo	516	528					
Hi_lo_port	480	510	513	516			
I	519	519	522	534	537		
Inc_i:	519	537					
Inc_j:	540	546	555				
Inc_l:	552	558	582				
J	510	540	540	543	546	558	564
	567	570					
K	525	531	531	534	585	588	594
	597	600	603	606	609	612	
	615	618					
L	549	552	552	555	558	564	
Last_cnt	576	579					
Line(	480	573					
Lines	480	576	576				
Lo:	585	528					
N	561	561	564	567	573		
Nfreqs	480	486	537	555			

Start	510						
Stop	513	543					
X	522	534	588	594	594	594	594
	594	594	594	594	600	600	600
	600	606	606	606	606	606	606
	612	612	612	612			

```
633  SUB F_step(Opt,Hi_lo_port,Max_pts,Nfreqs,F_list(*),Bail$,Proc)
636  OPTION BASE 1
639       Bail$="N"
642       MAT F_list=ZER
645  Start:  DISP "INPUT START,STOP,STEP(GHz) e.g., 2,.1 ";CHR$(7);
648          INPUT F1,F2,F3
651          PRINT LIN(2),"FREQUENCY INPUT IS FROM";F1;"TO";F2;"STEP"
                   ;F3;"GHz";CHR$(7)
654          CALL F_limt(F1,F2,F3,Opt,Hi_lo_port,Max_pts,Error)
657          IF Error THEN Err_test
660          IF F3=0 THEN Exit
663          Nfreqs=INT((F2-F1)/F3)+1
666  Incr:   Idx=Idx+1
669          IF Idx=Nfreqs THEN Exit
672          F_list(Idx+1)=F1+Idx*F3
675          IF Idx<Nfreqs THEN Incr
678  Exit:   F_list(1)=F1
681          IF F3=0 THEN Nfreqs=1
684          SUBEXIT
687  Err_test:    Times=Times+1
690          IF Times<=2 THEN Start
693          PRINT "DO YOU WANT TO CONTINUE ? -- (Y/N)";CHR$(7)
696          IF FNYorn THEN Start
699          Bail$="Y"
702  SUBEND
705  ! *************** SUBPROGRAM F_TYPE **********************
708  !  FILE NAME:  F_TYPE                 ! 811216-0900---BCY

S F_step(

Bail$              633    639    699

Err_test:          687    657

Error              654    657

Exit:              678    660    669

F1                 648    651    654    663    672    678

F2                 648    651    654    663

F3                 648    651    654    660    663    672    681

F_list(            633    642    672    678

Hi_lo_port         633    654

Idx                666    666    669    672    672    675

Incr:              666    675

Max_pts            633    654
```

Nfreqs	633	663	669	675	681
Opt	633	654			
Proc	633				
Start:	645	690	696		
Times	687	687	690		

```
711  SUB F_type(Opt,Hi_lo_port,Max_pts,Nfreqs,F(*),Bail$)
714   OPTION BASE 1
717   DIM Linput$[160]
720   Bail$="N"
723   MAT F=ZER
726  Start:  I=0
729         PRINT CHR$(12)
732         DISP " "
735         PRINT "INPUT FREQUENCY LIST -- ANY ORDER"
738         PRINT LIN(1);"TERMINATE FREQUENCY LIST WITH 0
                  IF LESS THAN ";Max_pts;" FREQUENCIES";CHR$(7)
741         PRINT LIN(1);"LIST TERMINATES WITH ";Max_pts;"
                  FREQUENCIES INPUT";CHR$(10);CHR$(7)
744  Incre:   I=I+1
747           DISP "INPUT F(";I;") GHz ";CHR$(7);
750           INPUT F(I)
753           IF NOT F(I) THEN Test1
756           PRINT "#";I;F(I);"GHz"
759           IF I<>Max_pts THEN Incre
762           I=I+1
765  Test1:   IF I=1 THEN Start
768              Nfreqs=I-1
771  Chng:    GOSUB Changes
774           DISP " "
777           CALL Order(F(*),Nfreqs)
780           CALL F_limt(F(1),F(Nfreqs),0,Opt,Hi_lo_port,Max_pts,Error
783           IF Error THEN GOSUB Err_test
786           IF Error THEN Chng
789  SUBEXIT
792  Changes:     DISP "CHANGES ?--(Y/N)";CHR$(7);
795               IF NOT FNYorn THEN RETURN
798               PRINT CHR$(12)
801               I=0
804  Inc:         I=I+1
807               PRINT "#";I;F(I);" GHZ"
810               IF I<>Nfreqs THEN Inc
813  List:        DISP "FREQUENCY LIST # ?";CHR$(7);
816               LINPUT " ",Linput$
819               IF NOT FNNumi(Linput$) THEN List
822               Digit=VAL(Linput$)
825               IF (Digit<=0) OR (Digit>Nfreqs) THEN List
828               DISP "CORRECTED # ";Digit;" ";CHR$(7);
831               INPUT F(Digit)
834               PRINT LIN(1);"CORRECTED #:"
837               PRINT SPA(5);"#";Digit;SPA(2);F(Digit);" GHz";CHR$(7)
840  GOTO Changes
843  Err_test:    Times=Times+1
846               IF Times<=2 THEN RETURN
849      PRINT LIN(2);"DO YOU WANT TO CONTINUE ? -- (Y/N)";CHR$(7)
852               IF FNYorn THEN RETURN
855               Bail$="Y"
858  SUBEND
861   !************* SUBPROGRAM PATH ************************
864   ! FILE NAME: PATH                    ! 811216-0930---BCY
```

S F_type(

Bail$	711	720	855				
Changes:	792	771	840				
Chng:	771	786					
Digit	822	825	825	828	831	837	837
Err_test:	843	783					
Error	780	783	786				
F(	711	723	750	753	756	777	780
	780	807	831	837			
Hi_lo_port	711	780					
I	726	744	744	747	750	753	756
	756	759	762	762	765	768	801
	804	804	807	807	810		
Inc:	804	810					
Incre:	744	759					
Linput$	717	816	819	822			
List:	813	819	825				
Max_pts	711	738	741	759	780		
Nfreqs	711	768	777	780	810	825	
Opt	711	780					
Start:	726	765					
Test1:	765	753					
Times	843	843	846				

```
867  SUB Path(Hi_lo_port,Nfreqs,F_list(*),Amps(*),Path(*))
870  OPTION BASE 1
873    Hi_lo=Hi_lo_port+1
876  Inc_i:    I=I+1
879           IF I>Nfreqs THEN SUBEXIT
882           X=F_list(I)
885           ON Hi_lo GOSUB Lo,Hi
888           ON Amp GOSUB Amp1,Amp2,Amp3,Amp4,Amp5
891           Path(I)=Path
894           IF Amp<=Last_amp THEN Inc_i
897           Amps(Amp)=Amp
900           Last_amp=Amp
903           IF I<Nfreqs THEN Inc_i
906  SUBEXIT
909  Lo:      Amp=1
912           IF X>1 THEN Amp=2
915  RETURN
918  Hi:      Amp=3
921           IF X>4 THEN Amp=4
924           IF X>7.8 THEN Amp=5
927   RETURN
930   Amp1:    Path=1
933            IF X>.35 THEN Path=2
936            IF X>.5 THEN Path=3
939            IF X>.7 THEN Path=4
942   RETURN
945   Amp2:    Path=5
948            IF X>1.3 THEN Path=6
951   RETURN
954   Amp3:    Path=7
957            IF X>2.5 THEN Path=8
960   RETURN
963   Amp4:    Path=9
966            IF X>5.4 THEN Path=10
969   RETURN
972   Amp5:    Path=11
975            IF X>10.5 THEN Path=12
978   RETURN
981   SUBEND
984  ! ************** SUBPROGRAM F_LIMT **********************
987  ! FILE NAME:  F_LIMT                    ! 811208-1600---BCY
```

```
S Path(


Amp                888     894     897     897     900     909     912
                   918     921     924

Amp1:              930     888

Amp2:              945     888

Amp3:              954     888

Amp4:              963     888
```

Amp5:	972	888					
Amps(	867	897					
F_list(	867	882					
Hi:	918	885					
Hi_lo	873	885					
Hi_lo_port	867	873					
I	876	876	879	882	891	903	
Inc_i:	876	894	903				
Last_amp	894	900					
Lo:	909	885					
Nfreqs	867	879	903				
Path	891	930	933	936	939	945	948
	954	957	963	966	972	975	
Path(	867	891					
X	882	912	921	924	933	936	939
	948	957	966	975			

```
990  SUB F_limt(F1,F2,F3,Opt,Hi_lo_port,Max_pts,Error)
993  OPTION BASE 1
996   Error=0
997   PRINT "HILOPORT";Hi_lo_port
999   IF Opt>1 THEN Test
1002  IF F1>F2 THEN Msg1
1005  IF F1+F3>F2 THEN Msg2
1008  IF (F1<>F2) EXOR (F3<>0) THEN Msg6
101   Min_step=(F2-F1)/(Max_pts-1)
1014  IF Min_step>F3 THEN Msg3
1017  Test:  IF Hi_lo_port AND (F2>18) OR NOT Hi_lo_port AND
             (F2>2) THEN Msg4
1020         IF Hi_lo_port AND (F1<2) OR NOT Hi_lo_port AND
             (F1<.25) THEN Msg5
1023  SUBEXIT
1026  Msg1:  PRINT "START>STOP";CHR$(7)
1029  GOTO Exit
1032  Msg2:  PRINT "STEP TOO LARGE",CHR$(7)
1035  GOTO Exit
1038  Msg3:  IMAGE "MINIMUM STEP TO COVER RANGE REQUESTED IS ",
             Z.6D," GHZ",K
1041         PRINT USING Msg3;Min_step;CHR$(7)
1044  GOTO Exit
1047  Msg4:  PRINT "HIGH FREQUENCY OUT OF BOUNDS",CHR$(7)
1050  GOTO Exit
1053  Msg5:  PRINT "LOW FREQUENCY OUT OF BOUNDS",CHR$(7)
1056  GOTO Exit
1059  Msg6: PRINT "START,STOP,STEP FREQUENCIES ARE INCONSISTENT",
           ,CHR$(7)
1062  Exit:  Error=1
1065  SUBEND
1068 ! *************** SUBROUTINE CALDAT *********************
1071 ! FILE NAME :  CALDAT                  ! 810916-2120---BCY
1074 !

S F_limt(


Error              990    996   1062
Exit:             1062   1029   1035   1044   1050   1056
F1                 990   1002   1005   1008   1011   1020   1020
F2                 990   1002   1005   1008   1011   1017   1017
F3                 990   1005   1008   1014
Hi_lo_port         990    997   1017   1017   1020   1020
Max_pts            990   1011
Min_step          1011   1014   1041
Msg1:             1026   1002
```

Msg2:	1032	1005
Msg3:	1038	1014
Msg4:	1047	1017
Msg5:	1053	1020
Msg6:	1059	1008
Opt	990	999
Test:	1017	999

```
1077 SUB Caldat(Max_pts,Nfreqs,Repeats,Dim,Hi_lo_port,Freq_a(*),
         Typ$,Sp,Std_mnt,Print$,Path_a(*),Line(*),Lines,Fstop_a(*),
         Cnnct$,Mounts,Sn(*),Cal)
1080 OPTION BASE 1
1083 DIM Freq_o(Nfreqs),Path_o(Nfreqs),Fstop_o(1),Type$[7],
         Id_content$[80]
1086 DIM Map(Nfreqs),Power(Nfreqs,Repeats,Dim,10),Rvg1(2),
         Rvg2(2),Pi(Nfreqs,2,Repeats,Dim),Pmnt(Nfreqs,Repeats,Dim,2)
1089 REDIM Freq_a(Nfreqs),Path_a(Nfreqs),Fstop_a(Nfreqs)
1092 PRINTER IS 16
1093 Cal$=VAL$(Cal)
1095 CALL Fdata(Nfreqs,Freq_a(*),Freq_o(*),Path_a(*),Path_o(*),
                Fstop_o(*),Map(*))
1098   Typ_flag=POS(Typ$,"P")
1101   IF Typ_flag>1 THEN Meas_x!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
1104 ! -------------- CALIBRATE ALL BUT LINES ---------------
1107   End=1
1110   Devices=6
1113   Type$="ORDERED"
1116 CALL Measre(Type$,Repeats,End,Freq_o(*),Path_o(*),Line(*),
                 Fstop_o(*),Hi_lo_port,Nfreqs,Devices,Rvg1(*),
                 Rvg2(*),Power(*),Map(*),Typ$,Sp,Pi(*),Pmnt(*),
                 Sn(*))
1119 ! ------------------ MEASURE AIR LINE(S) ---------------
1122  End=4
1125  Devices=Lines
1128  Type$="AIRLINE"
1131  CALL Measre(Type$,Repeats,End,Freq_a(*),Path_a(*),Line(*),
                  Fstop_a(*),Hi_lo_port,Nfreqs,Devices,Rvg1(*),
                  Rvg2(*),Power(*),Map(*),Typ$,Sp,Pi(*),Pmnt(*),
                  Sn(*))
1134  GOTO Index
1137 ! ------------- 1-PORT, 2-PORT, POWER MOUNT ------------
1140 Meas_x:  End=1+3*(Typ_flag=2)!!!!!!!!!!!!!!!!!!!!!!!!!!
1143          Devices=1+Mounts
1146          Type$="ORDERED"
1149 CALL Measre(Type$,Repeats,End,Freq_o(*),Path_o(*),Line(*),
                 Fstop_o(*),Hi_lo_port,Nfreqs,Devices,Rvg1(*),
                 Rvg2(*),Power(*),Map(*),Typ$,Sp,Pi(*),Pmnt(*),
                 Sn(*))
1152 !        IF Typ_flag=4 THEN Disc
1155 !        IF Typ_flag<>3 THEN Index
1158 !        IF (Typ_flag=3) AND (Sp=3) THEN Index
1159  GOTO Index !!!!!!!!!!!!!!!!!!!
1161  ! ------------ ZERO POWER ARRAY FOR ONE 1-PORT------------
1164        Col=6
1167        K=1
1170        IF Sp=2 THEN Col=1
1173 Inci:    I=I+1
1176       IF I>Nfreqs THEN Index
1179        J=0
1182 Incj:  J=J+1
1185        IF J>Repeats THEN Inci
1188        L=-1
1191 Incl:    L=L+1
```

```
1194        IF L>3 THEN Incj
1197        Power(I,J,K,L+Col)=0
1200   GOTO Incl
1203  ! ----------------- RE-INDEX POWER MATRIX --------------
1206   Index:   I=0
1209        Stopk=16*(Typ_flag<2)+4*(Typ_flag=2)+(Typ_flag>2)
                    +(Typ_flag=4)+Mounts
1212  !       Stopk=Dim !!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
1215   Inc_i:   I=I+1
1218         IF I>Nfreqs THEN Disc
1221         J=0
1224   Inc_j:   J=J+1
1227         IF J>Repeats THEN Inc_i
1230         K=0
1233   Inc_k:   K=K+1
1236         IF K>Stopk THEN Inc_j
1239         L=0
1242   Inc_l:   L=L+1
1245         IF L>4 THEN Inc_k
1248         Power(I,J,K,L+4)=Power(I,J,K,L+5)
1251   GOTO Inc_l
1254  ! ------------ DISK WRITE TO SCATCH PADS ----------------
1257   Disc:    Dtg$=FNDtg$
1260            Date$=Dtg$[1,6]
1261            Time$=Dtg$[8,13]
1262            MASS STORAGE IS ":F8,1"
1263            Ca$=VAL$(Cal)
1264   !     FOR I=1 TO 50
1265   !     IF Typ$="1_port" THEN GOTO 1269
1266   !     ASSIGN #1 TO "PWRH"&VAL$(I)&":F8,1",Check
1267   !     GOTO 1270
1269   !     ASSIGN #1 TO "1PRH"&VAL$(I)&":F8,1",Check
1270   !     ASSIGN #1 TO *
1271   !     IF Check THEN Ca$=VAL$(I)
1272   !     IF Check THEN GOTO 1276
1274   !     NEXT I
1276   ON Typ_flag+1 GOSUB Typ01,Typ01,Typ2,Typ3,Typ4
1277  PRINT CHR$(7)
1278  LINPUT "ENTER ANY 80 CHARACTER STRING TO IDENTIFY DATA",
             Id_content$
1279      CALL Wrthed(Fileo$,":F8,1",0,Date$,Time$,Typ$,Nfreqs,
                      Freq_o(*),Repeats,Sp,Std_mnt,Id_content$,
                      Cnnct$)
1280      CALL Wrtbin(Filed$,":F8,1",Power(*),Records)
1281      MASS STORAGE IS ":F8,0"
1284  ! -------------------- PRINT OUT ----------------------
1287      DISP "DO YOU WANT PRINT OUT OF POWER DATA ? -- (Y/N)";
               CHR$(7);
1290      IF NOT FNYorn THEN SUBEXIT
1293      CALL Prtpwr(Print$,Nfreqs,Repeats,Typ_flag,Rvg1(*),
                      Rvg2(*),Freq_o(*),Power(*),Date$,Time$,Pi(*),
                      Mounts,Dim)
1296   SUBEXIT
1299   Typ01:   Fileo$="PWR"&"H"&Ca$
1302            Filed$="PWR"&"D"&Ca$
```

```
1305           Records=INT(Max_pts*3*16*10*8/256)+4
1308  RETURN
1311  Typ2:  Fileo$="2PORTH"
1314         Filed$="2PORTD"
1317         Records=INT(Max_pts*10*4*10*8/256)+4
1320  RETURN
1323  Typ3:   Fileo$="1PRH"&"3"
1326          Filed$="1PRD"&"3"
1329          Records=INT(Max_pts*10*1*10*8/256)+4
1332  RETURN
1335  Typ4:   Fileo$="PRMNTH"
1338          Filed$="PRMNTD"
1341          Records=INT(Max_pts*3*10*10*8/256)+4
1344  RETURN
1347  SUBEND
1350 ! ************** SUBPROGRAM PRTPWR *********************
1353 !  FILE NAME:  PRTPWR                ! 811217-1630---BCY
```

```
S Caldat(

Ca$              1263   1299   1302

Cal              1077   1093   1263

Cal$             1093

Cnnct$           1077   1279

Col              1164   1170   1197

Date$            1260   1279   1293

Devices          1110   1116   1125   1131   1143   1149

Dim              1077   1086   1086   1086   1293

Disc:            1257   1218

Dtg$             1257   1260   1261

End              1107   1116   1122   1131   1140   1149

Filed$           1280   1302   1314   1326   1338

Fileo$           1279   1299   1311   1323   1335

Freq_a(          1077   1089   1095   1131

Freq_o(          1083   1095   1116   1149   1279   1293

Fstop_a(         1077   1089   1131

Fstop_o(         1083   1095   1116   1149
```

Hi_lo_port 1077 1116 1131 1149

I 1173 1173 1176 1197 1206 1215 1215
1218 1248 1248

Id_content$ 1083 1278 1279

Inc_i: 1215 1227

Inc_j: 1224 1236

Inc_k: 1233 1245

Inc_l: 1242 1251

Inci: 1173 1185

Incj: 1182 1194

Incl: 1191 1200

Index: 1206 1134 1159 1176

J 1179 1182 1182 1185 1197 1221 1224
1224 1227 1248 1248

K 1167 1197 1230 1233 1233 1236 1248
1248

L 1188 1191 1191 1194 1197 1239 1242
1242 1245 1248 1248

Line(1077 1116 1131 1149

Lines 1077 1125

Map(1086 1095 1116 1131 1149

Max_pts 1077 1305 1317 1329 1341

Meas_x: 1140 1101

Mounts 1077 1143 1209 1293

Nfreqs 1077 1083 1083 1086 1086 1086 1086
1089 1089 1089 1095 1116 1131 1149
1176 1218 1279 1293

Path_a(1077 1089 1095 1131

Path_o(1083 1095 1116 1149

Pi(1086 1116 1131 1149 1293

Pmnt(1086 1116 1131 1149

Power(1086 1116 1131 1149 1197 1248 1248
1280 1293

Print$ 1077 1293

Records 1280 1305 1317 1329 1341

Repeats 077 1086 1086 1086 1116 1131 1149
1185 1227 1279 1293

Rvg1(1086 1116 1131 1149 1293

Rvg2(1086 1116 1131 1149 1293

Sn(1077 1116 1131 1149

Sp 1077 1116 1131 1149 1170 1279

Std_mnt 1077 1279

Stopk 1209 1236

Time$ 1261 1279 1293

Typ$ 1077 1098 1116 1131 1149 1279

Typ01: 1299 1276 1276

Typ2: 1311 1276

Typ3: 1323 1276

Typ4: 1335 1276

Typ_flag 1098 1101 1140 1209 1209 1209 1209
1276 1293

Type$ 1083 1113 1116 1128 1131 1146 1149

```
1356  SUB Prtpwr(Print$,Nfreqs,Repeats,Typ_flag,Rvgav1(*),
                 Rvgav2(*),Freq_o(*),Power(*),Date$,Time$,Pi(*),
                 Mounts,Dim)
1359  OPTION BASE 1
1362  DISP " "
1365  IF POS(Print$,",") THEN PRINTER IS 7,1
1368  IF POS(Print$,"0") THEN PRINTER IS 0
1371  PRINT TAB(10);"RVG1 (VOLTS)";TAB(44);"RVG2 (VOLTS)";TAB(67);
           Date$&"."&Time$
1374  PRINT USING Header0;Rvgav1(1);Rvgav1(2);Rvgav2(1);Rvgav2(2)
1375  PRINT LIN(2);TAB(29);"SIDE-ARM POWER DATA"
1380  PRINT TAB(33);"MILLIWATTS"
1383  Stopk=Dim
1386  Inci:  I=I+1
1389       IF I>Nfreqs THEN Exit
1392       PRINT USING Header1;"FREQUENCY";Freq_o(I);" GHz";Repeats;
                " REPEAT(S)"
1395       PRINT LIN(1);TAB(19);"6-PORT #1";TAB(43);CHR$(124);
                TAB(59);"6-PORT #2";LIN(1)
1398       PRINT USING Header2;"MNT1 ";"MNT2 ";"MNT3 ";"MNT4 ";
                "MNT1 ";"MNT2 ";"MNT3 ";"MNT4 "
1401       K=0
1404  Inck:  K=K+1
1407       IF K>Stopk THEN Inci
1410       Swc1=Swc2=Swp1=Swp2=0
1413       IF Typ_flag>2 THEN J_loop
1416       IF Typ_flag=2 THEN Two_p
1419       IF K=1 THEN PRINT "POWER MOUNT"
1422       IF K=3 THEN PRINT "SHORT"
1425       IF K=4 THEN PRINT "OPEN"
1428       IF K=5 THEN PRINT "THRU"
1431       IF K=9 THEN PRINT "LINE"
1434       IF K=13 THEN PRINT "TWO PORT"
1437       IF (K=5) OR (K=9) OR (K=13) THEN PRINT "0 DEGREES"
1440       IF (K=6) OR (K=10) OR (K=14) THEN PRINT "90 DEGREES"
1443       IF (K=7) OR (K=11) OR (K=15) THEN PRINT "180 DEGREES"
1446       IF (K=8) OR (K=12) OR (K=16) THEN PRINT "270 DEGREES"
1449       IF (K=7) OR (K=11) OR (K=15) THEN Swc1=1
1452       IF (K=8) OR (K=12) OR (K=16) THEN Swc2=1
1455       IF Swc1 THEN K=K+1
1458       IF Swc2 THEN K=K-1
1461   GOTO J_loop
1464   Two_p: IF K=1 THEN PRINT "0 DEGREES"
1467        IF K=2 THEN PRINT "90 DEGREES"
1470        IF K=3 THEN PRINT "180 DEGREES"
1473        IF K=3 THEN Swp1=1
1476        IF K=4 THEN PRINT "270 DEGREES"
1479        IF K=4 THEN Swp2=1
1482        IF Swp1 THEN K=K+1
1485        IF Swp2 THEN K=K-1
1488  J_loop: J=0
1491  FOR J=1 TO Repeats
1494        Pinc1=PROUND(Pi(I,1,J,K),-5)
1497        IF Pinc1=0 THEN Nextjj
150         Pinc2=PROUND(Pi(I,2,J,K),-5)
```

```
1503          PRINT "Pinc1= ";Pinc1,"Pinc2= ";Pinc2,"Pratio=";
                    PROUND(Pinc2/Pinc1,-5)
1506  Nextjj: NEXT J
1509  J=0
1512  Incj:   J=J+1
1515          IF J<=Repeats THEN L_loop
1518          PRINT
1521          IF Swc1 OR Swp1 THEN K=K-1
1524          IF Swc2 OR Swp2 THEN K=K+1
1527  GOTO Inck
1530  L_loop: L=0
1533  Incl:   L=L+1
1536          IF L>8 THEN PRINT
1539          IF L>8 THEN Incj
1542          PRINT USING Form1;Power(I,J,K,L)
1545   GOTO Incl
1548  Header0:    IMAGE #,2X,D.7D,6X
1551  Header1:    IMAGE //9A,3D.6D,4A,5X,2D,10A/
1554  Header2:    IMAGE 8(5X,5A)/
1557  Form1:      IMAGE #,2X,2D.5D
1560  Exit:   PRINTER IS 16
1563          DISP " "
1566  SUBEND
1569 ! ********** SUBPROGRAM FDATA **************************
1572 !   FILE NAME:   FDATA                 ! 811217-1400---BCY
```

S Prtpwr(

Date$	1356	1371					
Dim	1356	1383					
Exit:	1560	1389					
Form1:	1557						
Freq_o(	1356	1392					
Header0:	1548						
Header1:	1551						
Header2:	1554						
I	1386	1386	1389	1392	1494	1500	1542
Inci:	1386	1407					
Incj:	1512	1539					
Inck:	1404	1527					
Incl:	1533	1545					

J	1488	1491	1494	1500	1506	1509	1512
	1512	1515	1542				
J_loop:	1488	1413	1461				
K	1401	1404	1404	1407	1419	1422	1425
	1428	1431	1434	1437	1437	1437	1440
	1440	1440	1443	1443	1443	1446	1446
	1446	1449	1449	1449	1452	1452	1452
	1455	1455	1458	1458	1464	1467	1470
	1473	1476	1479	1482	1482	1485	1485
	1494	1500	1521	1521	1524	1524	1542
L	1530	1533	1533	1536	1539	1542	
L_loop:	1530	1515					
Mounts	1356						
Nextjj:	1506	1497					
Nfreqs	1356	1389					
Pi(	1356	1494	1500				
Pinc1	1494	1497	1503	1503			
Pinc2	1500	1503	1503				
Power(	1356	1542					
Print$	1356	1365	1368				
Repeats	1356	1392	1491	1515			
Rvgav1(	1356	1374	1374				
Rvgav2(	1356	1374	1374				
Stopk	1383	1407					
Swc1	1410	1449	1455	1521			
Swc2	1410	1452	1458	1524			
Swp1	1410	1473	1482	1521			
Swp2	1410	1479	1485	1524			
Time$	1356	1371					
Two_p:	1464	1416					
Typ_flag	1356	1413	1416				

```
1575 SUB Fdata(Nfreqs,Freq_a(*),Freq_o(*),Path_a(*),Path_o(*),
         Fstop_o(*),Map(*))
1578 OPTION BASE 1
1581   MAT Fstop_o=(Nfreqs)
1584   MAT Freq_o=Freq_a
1587   MAT Path_o=Path_a
1590   CALL Order(Freq_o(*),Nfreqs)
1593   CALL Order(Path_o(*),Nfreqs)
1596 Inc_i:   I=I+1
1599           IF I>Nfreqs THEN SUBEXIT
1602           Temp=Freq_o(I)
1605           J=0
1608 Inc_j:   J=J+1
1611           IF J>Nfreqs THEN Inc_i
1614           IF Freq_a(J)<>Temp THEN Inc_j
1617           Map(J)=I
1620   GOTO Inc_i
1623 SUBEND
1626 ! ********** SUBPROGRAM  MEASURE  ************************
1629 !  FILE NAME:   MEASRE                 ! 810916-2120---BCY
```

```
S Fdata(


Freq_a(          1575   1584   1614

Freq_o(          1575   1584   1590   1602

Fstop_o(         1575   1581

I                1596   1596   1599   1602   1617

Inc_i:           1596   1611   1620

Inc_j:           1608   1614

J                1605   1608   1608   1611   1614   1617

Map(             1575   1617

Nfreqs           1575   1581   1590   1593   1599   1611

Path_a(          1575   1587

Path_o(          1575   1587   1593

Temp             1602   1614
```

```
1632  SUB Measre(Type$,Repeats,End,Freq(*),Path(*),Aline(*),
                 Fstop(*),Hi_lo_port,Nfreqs,Devices,Rvg1(*),
                 Rvg2(*),Po_out(*),Map(*),Typ$,Sp,Pi(*),Pmnt(*),
                 Sn(*))
1635  OPTION BASE 1
1638  DIM Von(Repeats,10),Vinc(Repeats,10)
1641  DIM Cont$[41],Clear$[12]
1644  DIM Voff1(1,10),Voff2(1,10),Vioff1(1,10),Vioff2(1,10),
        Clir$[12]
1647  DIM Wait$[24],Clr$[18],Edit$[20],Cler$[12],Ec$[1],Clar$[12],
        Cnt$[41]
1650   Ec$=CHR$(27)
1653   Wait$="                  -- WAIT"
1656   Cont$=Ec$&"&a3r34C"&" -- PRESS 'CONTINUE' WHEN READY"
1659   Cnt$=Ec$&"&a3r26C"&" -- PRESS 'CONTINUE' WHEN READY"
1662   Clear$=Ec$&"m"&Ec$&"&a3r34C"&Ec$&"J"
1665   Clr$=Ec$&"m"&Ec$&"&a3r0C"&Ec$&"J"&Ec$&"&a3r9C"
1668   Cler$=Ec$&"m"&Ec$&"&a3r34C"&Ec$&"K"
1671   Edit$=Ec$&"&a3r16C"&Ec$&"Q"&"ED"&Ec$&"R"&Ec$&"B"&Ec$&"B"
           &Ec$&"l"
1674   Clar$=Ec$&"m"&Ec$&"&a3r26C"&Ec$&"J"
1677   Clir$=Ec$&"m"&Ec$&"&a3r28C"&Ec$&"J"
1680   Typ_flag=POS(Typ$,"P")
1683   Rvg_reads=10
1686   Voff_rds=Pwr_reads=Dvm_rds=2
1689   Nphase=End
1692   T_device=Aline(1)
1695   Mode=0
1698   CALL Fase_shft(4,Hi_lo_port)
1701   IF (Type$<>"ORDERED") AND (Nfreqs<>1) THEN Rfout
1702   IF Type$<>"ORDERED" THEN Pause
1704   IF Typ_flag=1 THEN GOSUB Device3
1707   IF Typ_flag=2 THEN GOSUB Device6
1710   IF Typ_flag=3 THEN GOSUB Device8
1713   IF Typ_flag=4 THEN GOSUB Device9
1716   IF Hi_lo_port AND (Typ_flag<>4) THEN OUTPUT 710;"5354"
1719   IF NOT Hi_lo_port OR (Typ_flag=4) THEN OUTPUT 710;"52545556"
1722   Rfout:  CALL Rfout("INIT",Path(*),Freq(*),1,1,Hi_lo_port)
1725   IF Type$<>"ORDERED" THEN Pause
1728   IF (Typ_flag=4) OR NOT Hi_lo_port THEN CALL Rvgs(Rvg_reads,
       Hi_lo_port,Typ_flag,Rvg1(*),Rvg2(*))
1731   IF (Typ_flag<>4) AND Hi_lo_port THEN CALL Rvgs(Rvg_reads,
       Hi_lo_port,Typ_flag,Rvg1(*),Rvg2(*))
1734   PRINT USING "K";Ec$&"V"
1737   WAIT 3000
1740   IF Typ_flag<>4 THEN PRINT Clear$;Cont$;CHR$(7)
1743   IF Typ_flag=4 THEN PRINT Clear$;Cnt$;CHR$(7)
1746   DISP " "
1749   Pause:   PAUSE
1752          IF Type$="ORDERED" THEN PRINT Clar$;Edit$
1755          IF Type$="AIRLINE" THEN PRINT Clear$;Edit$
1758          Stop=0
1761          Freqs=1
1764 ! ------------------ START MEASUREMENTS ------------------
1765    IF Type$<>"AIRLINE" THEN OUTPUT 717,718;"F3VR1S4T0,"
```

```
1766    CALL Fase_shft(1,Hi_lo_port)
1767    FOR Device=1 TO Devices
1770        IF Device>4 THEN Nphase=4
1773        IF Typ_flag=2 THEN Nphase=4
1776        IF Type$<>"AIRLINE" THEN Order
1779        Start=Stop+1
1782        Stop=Fstop(Freqs)+Start-1
1785        Cntphi=8
1788   GOTO Begin
1791   Order:  Start=1
1794           Stop=Nfreqs
1797   Begin:  Path=Path(Start)
1800 !      OUTPUT 710 USING "4(K/)";"71";"41";"4";"7"
1803 !      CALL Preads(Voff_rds,Hi_lo_port,1,Voff1(*),Vioff1(*))
1806 ! ---------------------- PHASE LOOP ----------------------
1809        FOR Phase=1 TO Nphase
1812           Cntphi=Cntphi+1
1815           IF (Cntphi=1) AND (Typ_flag=1) THEN Dev
1818           IF (Cntphi=2) AND (Typ_flag=0) THEN Cnnct
1821           IF (Cntphi=2) AND (Typ_flag<=1) THEN Dev
1824           IF Typ_flag>1 THEN Freqs
1827           IF Cntphi<>9 THEN Freqs
1830           IF Type$<>"AIRLINE" THEN Cntphi=13
1833 ! -------------- FREQUENCY AND REPEAT LOOP ---------------
1836  Freqs:    FOR Freqs=Start TO Stop
1839  Voff:     OUTPUT 710 USING "4(K/)";"71";"41";"4";"7"
1842            CALL Preads(Voff_rds,Hi_lo_port,1,Voff1(*),Vioff1(*))
1845  IF Typ_flag=4 THEN CALL Pwrmnt(Rvg1(*),Rvg2(*),Repeats,Freqs,
        Device,Pwr_reads,Pmnt(*))
1848  IF Type_flag<>4 THEN OUTPUT 710 USING "4(K/)";"71";"40";
        "4";"7"
1851  Repeat:         FOR Repeat=1 TO Repeats
1854   CALL Preads(Dvm_rds,Hi_lo_port,Repeat,Von(*),Vinc(*))
1857              NEXT Repeat
1860           OUTPUT 710 USING "4(K/)";"71";"41";"4";"7"
1863           CALL Preads(Voff_rds,Hi_lo_port,1,Voff2(*),Vioff2(*))
1866              IF Nfreqs=1 THEN Pcalc
1869              IF Freqs<>Stop THEN CALL Rfout("NEXT",Path(*),
                     Freq(*),Freqs,Start,Hi_lo_port)
1872              IF Freqs<>Stop THEN Pcalc
1875              IF (Freqs=Nfreqs) OR (Phase<>4) THEN CALL Rfout
                     ("FIRST",Path(*),Freq(*),Freqs,Start,Hi_lo_port)
1878              IF (Freqs=Nfreqs) OR (Phase<>4) THEN Pcalc
1881  CALL Rfout("NEXT",Path(*),Freq(*),Freqs,Start,Hi_lo_port)
1884 ! ----------------- CALCULATE POWER ----------------------
1887  Pcalc: !
1890  CALL Pcalc(Type$,Typ$,Hi_lo_port,Repeats,Cntphi,Freqs,Rvg1(*),
        Rvg2(*),Voff1(*),Voff2(*),Von(*),Vinc(*),Po_out(*),Map(*),
        Pi(*),Vioff1(*),Vioff2(*))
1893     NEXT Freqs
1896          IF (Device>4) OR (Type$="AIRLINE") OR (Typ$="2PORT")
                AND (Freqs-1=Stop) THEN CALL Fase_shft(Phase MOD
                4+1,Hi_lo_port)
1899 ! ------------ END FREQUENCY AND REPEAT LOOP -------------
1902  FOR I=Start TO Stop
```

```
1905      FOR J=1 TO Repeats
1908         IF Type$<>"ORDERED" THEN Aline
1911         PRINT "Pinc1= ";PROUND(Pi(I,1,J,Cntphi),-5),"Pinc2= ";
             PROUND(Pi(I,2,J,Cntphi),-5),"Pratio= ";PROUND(Pi(I,2,J,
                   Cntphi)/Pi(I,1,J,Cntphi),-5)
1914         GOTO Nxxtj
1917 Aline:  Pinc1=Pi(Map(I),1,J,Cntphi)
1920         Pinc2=Pi(Map(I),2,J,Cntphi)
1923         PRINT "Pinc1= ";PROUND(Pinc1,-5),"Pinc2= ";PROUND(Pinc2,-5),
                   "Pratio= ";PROUND(Pinc2/Pinc1,-5)
1926  Nxxtj: NEXT J
1929      FOR J=1 TO Repeats
1932         FOR K=1 TO 10
1935            IF Type$<>"ORDERED" THEN Nxtprt
1938            PRINT USING Form;Po_out(I,J,Cntphi,K)
1941    GOTO Nxtk
1944  Nxtprt:    PRINT USING Form;Po_out(Map(I),J,Cntphi,K)
1947  Nxtk:  NEXT K
1950      NEXT J
1953      PRINT
1956      PRINT
1959  NEXT I
1962         NEXT Phase
1965 ! ------------------ END PHASE LOOP ---------------------
1968         IF Typ_flag=1 THEN Test
1971         IF (Typ_flag<>4) AND (Device=1) THEN Test
1974         IF Device=Devices THEN Dev
1977         GOSUB Device2
1980         PAUSE
1983         PRINT Clir$;Edit$
1986  Test:  IF Typ_flag>1 THEN Dev
1989         IF NOT Typ_flag AND (Device=1) THEN Dev
1992  Cnnct:IF Type$<>"AIRLINE" THEN GOSUB Connect
1995         PRINT
1998         IF Type$<>"AIRLINE" THEN GOTO Paws
2001         IF Stop=Nfreqs THEN Paws
2004         Nxt_device=Aline(Stop+1)
2007         IF T_device<>Nxt_device THEN GOSUB Connect
2010         PRINT
2013         T_device=Nxt_device
2016  Paws:  IF Device=Devices THEN Dev
2019  IF Typ_flag<>4 THEN PRINT Clear$;Cont$;CHR$(7)
2022         IF Typ_flag=4 THEN PRINT Clear$;Cnt$;CHR$(7)
2025         PAUSE
2028         IF Typ_flag<>4 THEN PRINT Cler$;Edit$
2031         IF Typ_flag=4 THEN PRINT Clar$;Edit$
2034  Dev:NEXT Device
2037 ! --------------- END MEASUREMENT LOOP ------------------
2040  IF Type$<>"ORDERED" THEN Exit
2043  IF NOT ((Typ_flag=0) OR (Typ_flag=4)) THEN What
2046            FOR Freqs=1 TO Nfreqs
2049               FOR Reps=1 TO Repeats
2052               FOR Device=1 TO Devices
2055               FOR Mnt=1 TO 2
2058   Po_out(Freqs,Reps,Device,4+Mnt)=Pmnt(Freqs,Reps,Device,Mnt)
```

```
2061                NEXT Mnt
2064                   FOR I=7 TO 10
2067                       Po_out(Freqs,Reps,Device,I)=0
2070                   NEXT I
2073                NEXT Device
2076    GOTO Rep
2079    Sp2:              Po_out(Freqs,Reps,1,1)=Po_out(Freqs,Reps,1,6)
2082                      Po_out(Freqs,Reps,1,2)=Pmnt(Freqs,Reps)
2085                   FOR I=3 TO 5
2088                      Po_out(Freqs,Reps,1,I)=0
2091                   NEXT I
2094    Rep:           NEXT Reps
2097             NEXT Freqs
2100    What:   IF Typ_flag>1 THEN Exit
2103            IF Type$<>"AIRLINE" THEN SUBEXIT
2106    Exit:   PRINT Ec$&"m";CHR$(12)
2109            OUTPUT 710 USING "4(K/)";"71";"41";"4";"7"
2112    LOCAL 717,718
2115    RESET 717,718
2118    LOCAL 728
2121    OUTPUT 710;"C"
2124    PRINT CHR$(12)
2127    DISP " "
2130    SUBEXIT
2133 ! ------------- CONNECT DEVICES SUBROUTINES ---------------
2136    Connect:  DISP "CONNECT NEXT DEVICE ? -- (Y/N)";CHR$(7)
2139          D0=FNYorn
2142            IF D0 THEN T_airlin
2145            IF NOT D0 THEN PRINT Ec$&"m";CHR$(12);LIN(10);TAB(10);"
                PROGRAM HALT -- PRESS RUN TO RESTART"
2148  STOP
2151  T_airlin: IF Type$<>"AIRLINE" THEN Which
2154           PRINT USING "#,K";Clr$;"CONNECT ";Aline(Stop+1);
                           " CM AIR LINE";Cont$;CHR$(7)
2157  RETURN
2160  Which:     ON Device+1 GOTO Device1,Device2,Device3,Device4,
              Device5,Device6,Device72163 Device1:  PRINT "NOTHING"

2166  Device2:PRINT CHR$(12);Clr$;CHR$(7);"CONNECT MOUNT";
                  Sn(Device+1);"TO B1 AND 6-PORT 1";CHR$(13)
                  &CHR$(10);TAB(10);"MOUNT";Sn(Device+2);"TO B2"
2169          PRINT LIN(1);TAB(10);"IF MOUNT = 0, USE ANY MOUNT";
                    LIN(2);TAB(10);"
PRESS 'CONT' WHEN READY";CHR$(7);
2172  RETURN
2175  Device3:  IF Typ_flag THEN PRINT CHR$(12);Clr$;CHR$(7);
      "CONNECT SHORTS";Wait$
2178     IF NOT Typ_flag THEN PRINT CHR$(12);Clr$;CHR$(7);
         "CONNECT SHORTS";Cont$
2181  RETURN
2184  Device4:  PRINT USING "#,K";Clr$;"CONNECT OPENS";Cont$;CHR$(7)
2187  RETURN
2190  Device5:  PRINT USING "#,K";Clr$;"CONNECT THRU";Cont$;CHR$(7)
2193  RETURN
2196  Device6:  PRINT USING "#,K";Clr$;CHR$(7)
```

```
2199          IF Typ_flag<2 THEN PRINT USING "#,K";"CONNECT
                                2-PORT";Cont$
2202          IF Typ_flag=2 THEN PRINT USING "#,K";"CONNECT
                                2-PORT";Wait$
2205  RETURN
2208  Device7: PRINT USING "#,K";Clr$;"CONNECT ";Aline(1);" CM
                           AIR LINE";Cont$;CHR$(7)
2211 RETURN
2214 Device8  PRINT USING "#,K";Clr$;"CONNECT 1-PORT(S)";Wait$;
                           HR$(7)
2217 RETURN
2220 Device9:PRINT CHR$(12);Clr$;CHR$(7);"CONNECT STD MOUNT";Sn(1);
             "TO B1 AND 6-PORT 1";CHR$(13)&CHR$(10);TAB(10);
             "MOUNT WITH SERIAL NUMBER";Sn(2);"TO B2";Wait$
2223 RETURN
2226 Form:  IMAGE #,10(D.5D,X)
2229 SUBEND
2232 ! *************** SUBPROGRAM RVGS **********************
2235 !   FILE NAME:  RVGS                 ! 810526-1455---BCY

S Measre(

Aline(          1632   1692   2004   2154   2208

Aline:          1917   1908

Begin:          1797   1788

Clar$           1647   1674   1752   2031

Clear$          1641   1662   1740   1743   1755   2019   2022

Cler$           1647   1668   2028

Clir$           1644   1677   1983

Clr$            1647   1665   2154   2166   2175   2178   2184
                2190   2196   2208   2214   2220

Cnnct:          1992   1818

Cnt$            1647   1659   1743   2022

Cntphi          1785   1812   1812   1815   1818   1821   1827
                1830   1890   1911   1911   1911   1911   1917
                1920   1938   1944

Connect:        2136   1992   2007

Cont$           1641   1656   1740   2019   2154   2178   2184
                2190   2199   2208

D0              2139   2142   2145

Dev:            2034   1815   1821   1974   1986   1989   2016
```

Device 1767 1770 1845 1896 1971 1974 1989
2016 2034 2052 2058 2058 2067 2073
2160 2166 2166

Device1: 2163 2160

Device2: 2166 1977 2160

Device3: 2175 1704 2160

Device4: 2184 2160

Device5: 2190 2160

Device6: 2196 1707 2160

Device7: 2208 2160

Device8: 2214 1710

Device9: 2220 1713

Devices 1632 1767 1974 2016 2052

Dvm_rds 1686 1854

Ec$ 1647 1650 1656 1659 1662 1662 1662
1665 1665 1665 1665 1668 1668 1668
1671 1671 1671 1671 1671 1671 1674
1674 1674 1677 1677 1677 1734 2106
2145

Edit$ 1647 1671 1752 1755 1983 2028 2031

End 1632 1689

Exit: 2106 2040 2100

Form: 2226

Freq(1632 1722 1869 1875 1881

Freqs 1761 1782 1836 1845 1869 1869 1872
1875 1875 1878 1881 1890 1893 1896
2046 2058 2058 2067 2079 2079 2082
2082 2088 2097

Freqs: 1836 1824 1827

Fstop(1632 1782

Hi_lo_port 1632 1698 1716 1719 1722 1728 1728
1731 1731 1766 1842 1854 1863 1869
1875 1881 1890 1896

I 1902 1911 1911 1911 1911 1917 1920
1938 1944 1959 2064 2067 2070 2085
2088 2091

J 1905 1911 1911 1911 1911 1917 1920
1926 1929 1938 1944 1950

K 1932 1938 1944 1947

Map(1632 1890 1917 1920 1944

Mnt 2055 2058 2058 2061

Mode 1695

Nfreqs 1632 1701 1794 1866 1875 1878 2001
2046

Nphase 1689 1770 1773 1809

Nxt_device 2004 2007 2013

Nxtk: 1947 1941

Nxtprt: 1944 1935

Nxxtj: 1926 1914

Order: 1791 1776

Path 1797

Path(1632 1722 1797 1869 1875 1881

Pause: 1749 1702 1725

Paws: 2016 1998 2001

Pcalc: 1887 1866 1872 1878

Phase 1809 1875 1878 1896 1962

Pi(1632 1890 1911 1911 1911 1911 1917
1920

Pinc1 1917 1923 1923

Pinc2 1920 1923 1923

Pmnt(1632 1845 2058 2082

Po_out(1632 1890 1938 1944 2058 2067 2079
2079 2082 2088

Pwr_reads 1686 1845

Rep: 2094 2076

Repeat 1851 1854 1857

Repeat: 1851

Repeats 1632 1638 1638 1845 1851 1890 1905
1929 2049 2049 2058 2058 2067 2079
2079 2082 2082 2088 2094

Rfout: 1722 1701

Rvg1(1632 1728 1731 1845 1890

Rvg2(1632 1728 1731 1845 1890

Rvg_reads 1683 1728 1731

Sn(1632 2166 2166 2220 2220

Sp 1632

Sp2: 2079

Start 1779 1782 1791 1797 1836 1869 1875
1881 1902

Stop 1758 1779 1782 1794 1836 1869 1872
1896 1902 2001 2004 2154

T_airlin: 2151 2142

T_device 1692 2007 2013

Test: 1986 1968 1971

Typ$ 1632 1680 1890 1896

Typ_flag 1680 1704 1707 1710 1713 1716 1719
1728 1728 1731 1731 1740 1743 1773
1815 1818 1821 1824 1845 1968 1971
1986 1989 2019 2022 2028 2031 2043
2100 2175 2178 2199 2202

Type$ 1632 1701 1702 1725 1752 1755 1765
1776 1830 1890 1896 1908 1935 1992
1998 2040 2103 2151

Type_flag 1848

Vinc(1638 1854 1890

Vioffl(1644 1842 1890

Vioff2(	1644	1863	1890			
Voff1(	1644	1842	1890			
Voff2(	1644	1863	1890			
Voff:	1839					
Voff_rds	1686	1842	1863			
Von(	1638	1854	1890			
Wait$	1647	1653	2175	2202	2214	2220
What:	2100	2043				
Which:	2160	2151				

```
2238 SUB Rvgs(Reads,Hi_lo_port,Typ_flag,Rvgav1(*),Rvgav2(*))
2241 OPTION BASE 1
2244 DIM Rvg1$(Reads+1),Rvg2$(Reads+1),Temp1(Reads),Temp2(Reads)
2247 Start: Dvm1=717
2250        Dvm2=718
2253      Stopj=1
2256     IF NOT Hi_lo_port OR (Typ_flag=4) THEN OUTPUT 710;"5556"
2259     IF NOT Hi_lo_port OR (Typ_flag=4) THEN J=1
2262     IF NOT Hi_lo_port OR (Typ_flag=4) THEN Stopj=2
2265     IF NOT Hi_lo_port OR (Typ_flag=4) THEN Inc=1
2268     OUTPUT Dvm1,Dvm2 USING Initial
2271     OUTPUT 709;"0919"
2274 Incj:  J=J+1
2277        IF J>Stopj THEN Exit
2280         CALL Dvms(Reads,Rvg1$(*),Rvg2$(*))
2283         I=0
2286 Inci:  I=I+1
2289        IF I>Reads THEN Test
2292         Temp1(I)=-VAL(Rvg1$(I+1))
2295         Temp2(I)=-VAL(Rvg2$(I+1))
2298   GOTO Inci
2301 Test:  Rvgtest=Rvgav1(J)=SUM(Temp1)/Reads
2304    GOSUB Swtch
2307         Rvgtest=Rvgav2(J)=SUM(Temp2)/Reads
2310         IF NOT Hi_lo_port THEN GOSUB Swtch
2313   Maxs=Maxt=0
2316   Mins=Mint=9
2319   I=0
2322 Inc_i: I=I+1
2325        IF I>Reads-1 THEN Var
2328         Max1=MAX(Temp1(I),Temp1(I+1))
2331         Min1=MIN(Temp1(I),Temp1(I+1))
2334         Max2=MAX(Temp2(I),Temp2(I+1))
2337         Min2=MIN(Temp2(I),Temp2(I+1))
2340        IF Max1>Maxs THEN Maxs=Max1
2343        IF Min1<Mins THEN Mins=Min1
2346        IF Max2>Maxt THEN Maxt=Max2
2349        IF Min2<Mint THEN Mint=Min2
2352   GOTO Inc_i
2355 Var: Var1=Maxs-Mins
2358      Var2=Maxt-Mint
2361    PRINT USING "K";CHR$(27)&"&a15R"
2364    Secline:  PRINT "MAXIMUM VARIATION WITH ";Reads;
                  "READINGS ON RVG(";J+Inc;");"=";Var1;LIN(1);
                  TAB(41);"RVG(";J+Inc+1;") = ";Var2;" VOLTS"
2367           Inc=Inc+1
2370 !  IF NOT Hi_lo_port OR (Hi_lo_port=2) THEN OUTPUT 710;"5556"
2373  GOTO Incj
2376  Swtch:  IF Rvgtest<2 THEN DISP "RVG MECHANICAL SWITCH(ES)
              ARE IN THE WRONG POSITION OR SCANNER IS OFF -- PAUSE";
              CHR$(7)
2379          IF Rvgtest>2 THEN RETURN
2382         PAUSE
2385         LOCAL Dvm1,Dvm2
2388         RESET Dvm1,Dvm2
```

```
2391          WAIT 3000
2394          GOTO Start
2397 Exit:  OUTPUT 709;"C"
2400   LOCAL Dvm1,Dvm2
2403   RESET Dvm1,Dvm2
2406   IF Hi_lo_port AND (Typ_flag<>4) THEN OUTPUT 710;"5,5354"
2409 Initial:IMAGE "F3VR1S7T0,"
2412 SUBEND
2415 ! ***************** SUBPROGRAM DVMS **********************
2418 !   FILE NAME:   DVMS                ! 810514-1805---BCY

S Rvgs(


Dvm1              2247   2268   2385   2388   2400   2403

Dvm2              2250   2268   2385   2388   2400   2403

Exit:             2397   2277

Hi_lo_port        2238   2256   2259   2262   2265   2310   2406

I                 2283   2286   2286   2289   2292   2292   2295
                  2295   2319   2322   2322   2325   2328   2328
                  2331   2331   2334   2334   2337   2337

Inc               2265   2364   2364   2367   2367

Inc_i:            2322   2352

Inci:             2286   2298

Incj:             2274   2373

Initial:          2409

J                 2259   2274   2274   2277   2301   2307   2364
                  2364

Max1              2328   2340   2340

Max2              2334   2346   2346

Maxs              2313   2340   2340   2355

Maxt              2313   2346   2346   2358

Min1              2331   2343   2343

Min2              2337   2349   2349

Mins              2316   2343   2343   2355

Mint              2316   2349   2349   2358
```

Reads	2238	2244	2244	2244	2244	2280	2289
	2301	2307	2325	2364			
Rvgl$(	2244	2280	2292				
Rvg2$(	2244	2280	2295				
Rvgavl(	2238	2301					
Rvgav2(	2238	2307					
Rvgtest	2301	2307	2376	2379			
Secline:	2364						
Start:	2247	2394					
Stopj	2253	2262	2277				
Swtch:	2376	2304	2310				
Temp1(	2244	2292	2301	2328	2328	2331	2331
Temp2(	2244	2295	2307	2334	2334	2337	2337
Test:	2301	2289					
Typ_flag	2238	2256	2259	2262	2265	2406	
Var1	2355	2364					
Var2	2358	2364					
Var:	2355	2325					

```
2421 SUB Dvms(Reads,V1$(*),V2$(*))
2424 OPTION BASE 1
2427    Dvm1=717
2430    Dvm2=718
2433        ON INT #7,2 GOSUB Srq
2436         CONTROL MASK 7;128
2439         CARD ENABLE 7
2442         OUTPUT Dvm1,Dvm2;"@"
2445         I=1
2448         Reads1=Reads+1
2451 Idle: !
2454   GOTO Idle
2457 Srq:      ENTER Dvm1 BINT NOFORMAT;V1$(I)
2460           IF I=Reads1 THEN Dvm2
2463           OUTPUT Dvm1;"@"
2466 Dvm2:     ENTER Dvm2 BINT NOFORMAT;V2$(I)
2469          IF I=Reads1 THEN Exit
2472           OUTPUT Dvm2;"@"
2475           I=I+1
2478 RETURN
2481 Exit:  OUTPUT Dvm1,Dvm2;"%"
2484 SUBEND
2487 ! ***************** READ POWER ****************************
2490 ! FILE NAME:  PREADS                    ! 810608-1110---BCY
```

S Dvms(

Dvm1	2427	2442	2457	2463	2481		
Dvm2	2430	2442	2466	2472	2481		
Dvm2:	2466	2460					
Exit:	2481	2469					
I	2445	2457	2460	2466	2469	2475	2475
Idle:	2451	2454					
Reads	2421	2448					
Reads1	2448	2460	2469				
Srq:	2457	2433					
V1$(	2421	2457					
V2$(	2421	2466					

```
2493 SUB Preads(Reads,Hi_lo_port,Repeat,Volts(*),Vinc(*))
2496 OPTION BASE 1
2499 DIM Decade$[4],V1$(Reads+1),V2$(Reads+1),Temp1(Reads),
       Temp2(Reads)
2502 !  IF Repeat=1 THEN OUTPUT 717,718 USING Initial
2505    Mnt=1
2508    Incr=1
2511    Incp$="00"
2514    Port$="3"    ! port #1
2517 !      IF NOT Hi_lo_port THEN OUTPUT 710;"5556"
2520 Incmnt: Mnt=Mnt+1
2523         IF Mnt>9 THEN Exit
2526         Mnt$=VAL$(Incr)
2529         OUTPUT 709;Incp$&Port$&Mnt$
2532         IF Mnt>5 THEN Mnt789
2535         CALL Dvms(Reads,V1$(*),V2$(*))
2538         FOR I=1 TO Reads
2541           Temp1(I)=VAL(V1$(I+1))    ! Mnt1
2544           Temp2(I)=VAL(V2$(I+1))    ! Mnt234
2547         NEXT I
2550   GOSUB Ave
2553   GOTO Incr
2556 Mnt789: CALL Dvms(Reads,V1$(*),V2$(*))
2559         FOR I=1 TO Reads
2562           Temp1(I)=VAL(V2$(I+1))    ! Mnt1
2565           Temp2(I)=VAL(V1$(I+1))    ! Mnt789
2568         NEXT I
2571   GOSUB Ave
2574 Incr:   Incr=Incr+1
2577         IF (Mnt<4) OR (Mnt>6) THEN GOTO Incmnt
2580          Mnt=Mnt+2
2583          Port$="2"
2586          Incp$="10"
2589          Incr=1
2592          OUTPUT 709;"C"
2595   GOTO Incmnt
2598 Exit: OUTPUT 709;"C"
2601 !    IF NOT Hi_lo_port THEN OUTPUT 710;"5,5254"
2604  SUBEXIT
2607 Ave: Vinc(Repeat,Mnt)=SUM(Temp1)/Reads
2610      Volts(Repeat,Mnt)=SUM(Temp2)/Reads
2613  RETURN
2616 Initial: IMAGE "F3VR1S4T0,"
2619 SUBEND
2622 ! *************** SUBPROGRAM PCALC ************************
2625 !   FILE NAME:   PCALC                  ! 810807-1800---BCY

S Preads(


Ave:              2607   2550   2571

Decade$           2499

Exit:             2598   2523
```

Hi_lo_port 2493

I 2538 2541 2541 2544 2544 2547 2559
2562 2562 2565 2565 2568

Incmnt: 2520 2577 2595

Incp$ 2511 2529 2586

Incr 2508 2526 2574 2574 2589

Incr: 2574 2553

Initial: 2616

Mnt 2505 2520 2520 2523 2532 2577 2577
2580 2580 2607 2610

Mnt$ 2526 2529

Mnt789: 2556 2532

Port$ 2514 2529 2583

Reads 2493 2499 2499 2499 2499 2535 2538
2556 2559 2607 2610

Repeat 2493 2607 2610

Templ(2499 2541 2562 2607

Temp2(2499 2544 2565 2610

V1$(2499 2535 2541 2556 2565

V2$(2499 2535 2544 2556 2562

Vinc(2493 2607

Volts(2493 2610

```
2628 SUB Pcalc(Type$,Typ$,Hi_lo_port,Repeats,Count,Freqs,Rvg1(*),
             Rvg2(*),Voff1(*),Voff2(*),Von(*),Vinc(*),P_out(*),
             Map(*),Pinc(*),Vioff1(*),Vioff2(*))
2631 OPTION BASE 1
2634 DIM Off_sum(1,10),Voff_ave(1,10)
2637 DIM Off_sumi(1,10),Voff_avei(1,10)
2640 DIM On(Repeats,10),Trvg1(2),Trvg2(2)
2643  Typ=POS(Typ$,"P")
2646  MAT Off_sum=Voff1+Voff2
2649  MAT Off_sumi=Vioff1+Vioff2
2652  MAT Voff_ave=Off_sum/(2)
2655  MAT Voff_avei=Off_sumi/(2)
2658  MAT On=Von
2661   GOTO Skprt1
2664   PRINTER IS 7,1    ! FOR PRINTOUT OF
2667   MAT PRINT Voff1   ! VOFFS AND VONS
2670   MAT PRINT Vioff1
2673   MAT PRINT Voff2
2676   MAT PRINT Vioff2
2679   MAT PRINT Von
2682   MAT PRINT Vinc
2685   PRINTER IS 16
2688 Skprt1: !
2691  MAT Trvg1=Rvg1*(2)
2694  MAT Trvg2=Rvg2*(2)
2697  F=Freqs
2700 Rep:  Rep=Rep+1
2703       IF Rep>Repeats THEN SUBEXIT
2706       Mnt=1
2709 Mnt:  Mnt=Mnt+1
2712       IF Mnt>4 THEN Rep
2715        Inc=NOT Hi_lo_port OR (Typ=4)
2718        Sum1=On(Rep,Mnt)+Voff_ave(1,Mnt)+Trvg2(1+Inc)
2721        Sum1i=Vinc(Rep,Mnt)+Voff_avei(1,Mnt)+Trvg1(1+Inc)
2724        Sum2=On(Rep,Mnt+5)+Voff_ave(1,Mnt+5)+Trvg1(1+Inc)
2727        Sum2i=Vinc(Rep,Mnt+5)+Voff_avei(1,Mnt+5)+Trvg2(1+Inc)
2730        Del1=Voff_ave(1,Mnt)-On(Rep,Mnt)
2733        Del1i=Voff_avei(1,Mnt)-Vinc(Rep,Mnt)
2736        Del2=Voff_ave(1,Mnt+5)-On(Rep,Mnt+5)
2739        Del2i=Voff_avei(1,Mnt+5)-Vinc(Rep,Mnt+5)
2742        IF Type$="AIRLINE" THEN A_line
2745        IF Mnt>2 THEN Skip
2748        Pinc(F,1,Rep,Count)=5*Sum1i*Del1i    !for display
2751        P_out(F,Rep,Count,2)=5*Sum1*Del1/(5*Sum1i*Del1i)
2754        Pinc(F,2,Rep,Count)=5*Sum2i*Del2i    !for display
2757        P_out(F,Rep,Count,7)=5*Sum2*Del2/(5*Sum2i*Del2i)
2760        P_out(F,Rep,Count,1)=P_out(F,Rep,Count,6)=1
2763    GOTO Mnt
2766 Skip:  Pinc1=5*Sum1i*Del1i
2769         P_out(F,Rep,Count,Mnt)=5*Sum1*Del1/Pinc1
2772         Pinc2=5*Sum2i*Del2i
2775         P_out(F,Rep,Count,Mnt+5)=5*Sum2*Del2/Pinc2
2778    GOTO Mnt
2781 A_line:   IF Mnt>2 THEN Skp
2784        Pinc(Map(F),1,Rep,Count)=5*Sum1i*Del1i
```

```
2787        Pinc(Map(F),2,Rep,Count)=5*Sum2i*Del2i
2790        P_out(Map(F),Rep,Count,1)=P_out(Map(F),Rep,Count,6)=1
2793        P_out(Map(F),Rep,Count,2)=5*Sum1*Del1/(5*Sum1i*Del1i)
2796        P_out(Map(F),Rep,Count,7)=5*Sum2*Del2/(5*Sum2i*Del2i)
2799    GOTO Mnt
2802 Skp:  Pinc1=5*Sum1i*Del1i
2805        Pinc2=5*Sum2i*Del2i
2808           P_out(Map(F),Rep,Count,Mnt)=5*Sum1*Del1/Pinc1
2811           P_out(Map(F),Rep,Count,Mnt+5)=5*Sum2*Del2/Pinc2
2814    GOTO Mnt
2817  SUBEND
2820 ! ********** SUBROUTINE SYNTHESIZER *****************
2823 ! FILE NAME:  SYNTH          ! 811208-1700---DHR & BCY
```

S Pcalc(

A_line:	2781	2742					
Count	2628	2748	2751	2754	2757	2760	2760
	2769	2775	2784	2787	2790	2790	2793
	2796	2808	2811				
Del1	2730	2751	2769	2793	2808		
Del1i	2733	2748	2751	2766	2784	2793	2802
Del2	2736	2757	2775	2796	2811		
Del2i	2739	2754	2757	2772	2787	2796	2805
F	2697	2748	2751	2754	2757	2760	2760
	2769	2775	2784	2787	2790	2790	2793
	2796	2808	2811				
Freqs	2628	2697					
Hi_lo_port	2628	2715					
Inc	2715	2718	2721	2724	2727		
Map(	2628	2784	2787	2790	2790	2793	2796
	2808	2811					
Mnt	2706	2709	2709	2712	2718	2718	2721
	2721	2724	2724	2727	2727	2730	2730
	2733	2733	2736	2736	2739	2739	2745
	2769	2775	2781	2808	2811		
Mnt:	2709	2763	2778	2799	2814		
Off_sum(	2634	2646	2652				
Off_sumi(	2637	2649	2655				

On(2640 2658 2718 2724 2730 2736

P_out(2628 2751 2757 2760 2760 2769 2775
2790 2790 2793 2796 2808 2811

Pinc(2628 2748 2754 2784 2787

Pinc1 2766 2769 2802 2808

Pinc2 2772 2775 2805 2811

Rep 2700 2700 2703 2718 2721 2724 2727
2730 2733 2736 2739 2748 2751 2754
2757 2760 2760 2769 2775 2784 2787
2790 2790 2793 2796 2808 2811

Rep: 2700 2712

Repeats 2628 2640 2703

Rvg1(2628 2691

Rvg2(2628 2694

Skip: 2766 2745

Skp: 2802 2781

Skprt1: 2688 2661

Sum1 2718 2751 2769 2793 2808

Sum1i 2721 2748 2751 2766 2784 2793 2802

Sum2 2724 2757 2775 2796 2811

Sum2i 2727 2754 2757 2772 2787 2796 2805

Trvg1(2640 2691 2721 2724

Trvg2(2640 2694 2718 2727

Typ 2643 2715

Typ$ 2628 2643

Type$ 2628 2742

Vinc(2628 2682 2721 2727 2733 2739

Vioff1(2628 2649 2670

Vioff2(2628 2649 2676

Voff1(2628 2646 2667

Voff2(	2628	2646	2673			
Voff_ave(	2634	2652	2718	2724	2730	2736
Voff_avei(	2637	2655	2721	2727	2733	2739
Von(	2628	2658	2679			

```
2826 SUB Synth(Mode,Freq,Last_freq,Level)
2827 !INSERTED GO TO AND CALL STATEMENT AT 2830 AND 2928
      RESP. 850724 1443 GJC
2829  Addr=728
2832  IF Level>6 THEN DISP "TOO MUCH SYNTHESIZER LEVEL CONTROL -- PROGRAM HALT"
2835  IF Level>6 THEN STOP
2838  Lvl=Level
2841  Freq_mhz=Freq*1E6
2844  IF (Freq>=-2) AND (Last_freq<2) OR (Freq<2) AND (Last_freq>
          =-2) THEN Attn_flag=1
2847  IF Attn_flag THEN Attn=6
2850  IF Attn_flag THEN Lo_lvl
2853   Attn=INT(ABS(Lvl/10))+2
2856  Lo_lvl:  Lo_lvl=350
2859           OUTPUT Addr USING Lvlout;Attn,Lo_lvl
2862           OUTPUT Addr USING Mode;Mode
2865           OUTPUT Addr USING Freq;Freq_mhz
2868           IF Attn_flag THEN Attn=INT(ABS(Lvl/10))+2
2871           Lvlout=ABS(Lvl*10-240)-(Attn-1)*100-(Lvl>0)
2874           OUTPUT Addr USING Lvlout;Attn,Lvlout
2877           Status$=VAL$(4)
2880 Status:  ENTER Addr;Status$
2883           Temp=VAL(Status$)
2886           IF NOT Temp THEN SUBEXIT
2889           Cnt=Cnt+1
2892           IF Cnt<101 THEN Status
2895           IF Temp=1 THEN PRINT "UNLOCKED";CHR$(7)
2898           IF Temp=2 THEN PRINT "UNLEVELED";CHR$(7)
2901           IF Temp=3 THEN PRINT "UNLOCKED & UNLEVELED";CHR$(7)
2904           Countr=Countr+1
2907           IF Countr<51 THEN Status
2910           DISP "DO YOU WANT TO CONTINUE ? -- (Y/N)";CHR$(7);
2913           Cnt=Countr=0
2916           IF FNYorn THEN Status
2919 STOP
2922 Mode: IMAGE "O",D
2925 Freq: IMAGE "H",8Z
2928 Lvlout:  IMAGE "N",D,3Z
2933 SUBEND
2934 ! ********** SUBPROGRAM FILTER *************************
2937 ! FILE NAME:   FILTER                 ! 810522-1630---BCY
```

```
S Synth(


Addr              2829   2859   2862   2865   2874   2880

Attn              2847   2853   2859   2868   2871   2874

Attn_flag         2844   2847   2850   2868

Cnt               2889   2889   2892   2913

Countr            2904   2904   2907   2913
```

Freq	2826	2841	2844	2844	
Freq:	2925				
Freq_mhz	2841	2865			
Last_freq	2826	2844	2844		
Level	2826	2832	2835	2838	
Lo_lvl	2856	2859			
Lo_lvl:	2856	2850			
Lvl	2838	2853	2868	2871	2871
Lvlout	2871	2874			
Lvlout:	2928				
Mode	2826	2862			
Mode:	2922				
Status$	2877	2880	2883		
Status:	2880	2892	2907	2916	
Temp	2883	2886	2895	2898	2901

```
2940 SUB Filter(Path)
2943 DIM Table$(12,2)[6],Data$[6],Pos$[2]
2946  Scanner=710
2949  Table$(1,1)="606162"
2952  Table$(1,2)=Null$
2955  Table$(2,1)="6061"
2958  Table$(2,2)="62"
2961  Table$(3,1)="6063"
2964  Table$(3,2)="61"
2967  Table$(4,1)="60"
2970  Table$(4,2)="6163"
2973  Table$(5,1)="64"
2976  Table$(5,2)="60"
2979  Table$(6,1)=Null$
2982  Table$(6,2)="6064"
2985  Table$(7,1)="656667"
2988  Table$(7,2)=Null$
2991  Table$(8,1)="6566"
2994  Table$(8,2)="67"
2997  Table$(9,1)="6568"
3000  Table$(9,2)="66"
3003  Table$(10,1)="65"
3006  Table$(10,2)="6668"
3009  Table$(11,1)="69"
3012  Table$(11,2)="65"
3015  Table$(12,1)=Null$
3018  Table$(12,2)="6569"
3021  Pos$=VAL$(40+(Path>6))
3024  OUTPUT Scanner USING "4(K/)";"70";Pos$;"4";"7"
3027  Pos: Pos=Pos+1
3030     IF Pos>2 THEN SUBEXIT
3033     Data$=Table$(Path,Pos)
3036     IF Data$=Null$ THEN Pos
3039     Pos$=VAL$(40+(Pos=2))
3042     OUTPUT Scanner USING "4(K/)";Data$;Pos$;"4";"6"
3045   GOTO Pos
3048 SUBEND
3051 ! ************** SUBPROGRAM FASE_SHFT *********************
3054 ! FILE NAME:   FASE                      ! 810522-1810---BCY

S Filter(


Data$              2943   3033   3036   3042

Null$              2952   2979   2988   3015   3036

Path               2940   3021   3033

Pos                3027   3027   3030   3033   3039

Pos$               2943   3021   3024   3039   3042

Pos:               3027   3036   3045
```

Scanner	2946	3024	3042				
Table$(	2943	2949	2952	2955	2958	2961	2964
	2967	2970	2973	2976	2979	2982	2985
	2988	2991	2994	2997	3000	3003	3006
	3009	3012	3015	3018	3033		

```
3057 SUB Fase_shft(I,Hi_lo_port)
3060 DIM In$[2],Out$[2],Pos_in$[2],Pos_out$[2],Off_in$[4],Off_out$[4]
3063  Temp=4*Hi_lo_port
3066  In$=VAL$(43+Temp)
3069  Out$=VAL$(44+Temp)
3072  Pos_in$=VAL$(40+((I=1) OR (I=2)))
3075  Pos_out$=VAL$(40+((I=1) OR (I=4)))
3078  Off_in$="4,"&In$
3081  Off_out$="4,"&Out$
3084  OUTPUT 710 USING "8(K/)";In$;Pos_in$;Off_in$;"4";Out$;Pos_out$;Off_out$;"4
"
3087 SUBEND
3090 ! ***************** SUBPROGRAM DAC **********************
3093 ! FILE NAME: DAC                      ! 810203-1830---BCY

S Fase_shft(


Hi_lo_port        3057   3063

I                 3057   3072   3072   3075   3075

In$               3060   3066   3078   3084

Off_in$           3060   3078   3084

Off_out$          3060   3081   3084

Out$              3060   3069   3081   3084

Pos_in$           3060   3072   3084

Pos_out$          3060   3075   3084

Temp              3063   3066   3069
```

```
3096  SUB Dac(Volts,Dac_err)
3099   Dac=706
3102   Dac_err=0
3105  IF (Volts<0) OR NOT (Volts<1) THEN Dac_err=1
3108  IF Dac_err THEN SUBEXIT
3111   Data$=VAL$(1000+INT(Volts/.001+.5))
3114   OUTPUT Dac USING "#,K";Data$
3117   SENDBUS Dac;191
3120 SUBEND
3123 ! ************* FUNCTION DTG-DATE TIME GROUP **************
3126 ! FILE NAME:  FNDTG$                    ! 80513-17300---BCY
```

```
S Dac(


Dac               3099   3114   3117

Dac_err           3096   3102   3105   3108

Data$             3111   3114

Volts             3096   3105   3105   3111
```

```
3129 DEF FNDtg$
3130  ! !!!!!CHANGED DATE FROM 84 TO 85 850724:GJC
3132  OUTPUT 9;"Read"
3135  ENTER 9;A$
3138  Dtg$="85"&A$[1,2]&A$[4,5]&"."&A$[7,8]&A$[10,11]&A$[13,14]
3141 RETURN Dtg$
3144 FNEND
3147 ! ***************** FUNCTION FNYORN ********************
3150 ! FILE NAME:  FNYORN                 ! 810101-1600---BCY

FNDtg$


A$                3135   3138   3138   3138   3138   3138

Dtg$              3138   3141
```

```
3153 DEF FNYorn
3156 Key: Key=READBIN(0)
3159      N=Answer=NOT ((Key=78) OR (Key=110))
3162      Y=Answer=(Key=89) OR (Key=121)
3165      IF NOT Y AND N THEN Key
3168      DISP
3171 RETURN Answer
3174 FNEND
3177 ******************** FUNCTION FNNUMI ********************
3180 ! FILE NAME:  FNNUMI                  ! 810101-1600---BCY
```

FNYorn

Answer	3159	3162	3171		
Key	3156	3159	3159	3162	3162
Key:	3156	3165			
N	3159	3165			
Y	3162	3165			

```
3183 DEF FNNumi(Linput$)
3186   Length=LEN(TRIM$(Linput$))
3189   IF NOT Length THEN RETURN 0
3192 Inci: I=I+1
3195       IF I>Length THEN RETURN 1
3198       Num=NUM(Linput$[I])
3201       IF (Num<=47) OR (Num>=58) THEN RETURN 0
3204   GOTO Inci
3207 FNEND
3210 ! ***************** FUNCTION FNNUMD ***********************
3213 !  FILE NAME:  FNNUMD                    ! 820302-1700---BCY
```

```
FNNumi(


I                3192   3192   3195   3198

Inci:            3192   3204

Length           3186   3189   3195

Linput$          3183   3186   3198

Num              3198   3201   3201
```

```
3216 DEF FNNumd(Linput$)
3219   Dec=0
3222   Len=LEN(TRIM$(Linput$))                          ! length
3225   IF NOT Len=0 THEN RETURN 0                     ! non-ASCII
3228 Inci: I=I+1
3231       IF I>Len THEN RETURN 1                     ! passes ok
3234       Num=NUM(Linput$[I])                        ! decimal value
3237       IF Num=46 THEN Test                        ! test decimal point
3240       IF (Num<=47) OR (Num>=58) THEN RETURN 0    ! not a number
3243   GOTO Inci
3246 Test: IF Num=46 THEN Dec=Dec+1                   ! a period
3249        IF (Dec>1) OR (LEN(Linput$)=1) THEN RETURN 0 ! none or too many or
3252   GOTO Inci                                      ! no number following
3255   SUBEND
3258 ! *************** SUBPROGRAM ORDER ***************************
3261 !   FILE NAME:  ORDER                      ! 820107-1530---BCY

FNNumd(


Dec               3219   3246   3246   3249

I                 3228   3228   3231   3234

Inci:             3228   3243   3252

Len               3222   3225   3231

Linput$           3216   3222   3234   3249

Num               3234   3237   3240   3240   3246

Test:             3246   3237
```

```
3264 SUB Order(F(*),Nfreqs)
3267 OPTION BASE 1
3270  IF Nfreqs=1 THEN SUBEXIT
3273  Stop_i=INT(Nfreqs/2)
3276  Inc_i: I=J=I+1
3279       IF I>Stop_i THEN SUBEXIT
3282       Min=Max=F(I)
3285       L=K=0
3288       Stop_j=Nfreqs-I+1
3291  Inc_j: J=J+1
3294       IF J>Stop_j THEN Swtch
3297       Compare=F(J)
3300       IF Compare>Min THEN Max
3303       K=J
3306       Min=Compare
3309  Max:  IF Compare<Max THEN Inc_j
3312        L=J
3315        Max=Compare
3318  GOTO Inc_j
3321  Swtch:IF F(I)=Min THEN Skip
3324        F(K)=F(I)
3327        F(I)=Min
3330  Skip: IF F(Stop_j)=Max THEN Inc_i
3333       IF NOT L THEN L=K
3336        F(L)=F(Stop_j)
3339        F(Stop_j)=Max
3342  GOTO Inc_i
3345  SUBEND
3348 ! ******************************************************
```

```
S Order(

Compare          3297   3300   3306   3309   3315

F(               3264   3282   3297   3321   3324   3324   3327
                 3330   3336   3336   3339

I                3276   3276   3279   3282   3288   3321   3324
                 3327

Inc_i:           3276   3330   3342

Inc_j:           3291   3309   3318

J                3276   3291   3291   3294   3297   3303   3312

K                3285   3303   3324   3333

L                3285   3312   3333   3333   3336

Max              3282   3309   3315   3330   3339

Max:             3309   3300
```

Min	3282	3300	3306	3321	3327
Nfreqs	3264	3270	3273	3288	
Skip:	3330	3321			
Stop_i	3273	3279			
Stop_j	3288	3294	3330	3336	3339
Swtch:	3321	3294			

```
3351 SUB Avg(Ave(*),Var(*),X(*),N)       ! 811108-0900---BCY
3354 OPTION BASE 1
3357 MAT Var=Var*(N-2)
3360 MAT X=X-Ave
3363 MAT X=X/(N)
3366 MAT Ave=X+Ave
3369 MAT X=X.X
3372 MAT X=X*((N-1)*N)
3375 MAT Var=Var+X
3378 MAT Var=Var/(N-1)
3381 SUBEND
3384 ! ***************** SUBPROGRAM RFOUT **********************
3387 !  FILE NAME:  RFOUT                    ! 820130-1300---BCY

S Avg(


Ave(              3351   3360   3366   3366

N                 3351   3357   3363   3372   3372   3378

Var(              3351   3357   3357   3375   3375   3378   3378

X(                3351   3360   3360   3363   3363   3366   3369
```

```
3390 SUB Rfout(Kind$,Path(*),Freq(*),Freqs,Start,Hilo)
3393 OPTION BASE 1
3396  Mode=0
3399  IF Kind$="NEXT" THEN Next
3402  IF Kind$="FIRST" THEN First
3405  N_freq=L_freq=Freq(1)
3408  Path=Path(1)
3411 GOTO Call
3414 First:N_freq=Freq(Start)
3417       L_freq=Freq(Freqs)
3420       Path=Path(Start)
3423 GOTO Call
3426 Next:N_freq=Freq(Freqs+1)
3429      L_freq=Freq(Freqs)
3432      Path=Path(Freqs+1)
3435 Call:CALL Filter(Path)
3438      CALL Pset(N_freq,Hilo,Dac_volt,Level)
3441      CALL Dac(Dac_volt,Err)
3444      CALL Synth(Mode,N_freq,L_freq,Level)
3447 SUBEND
3450 ! ***************** SUBPROGRAM PSET ***********************
3453 ! FILE NAME: PSET                        ! 820000-0000---BCY
3454 !******** RENAMED SUB PSET TO PSETDEL 850724:1446:GJC

S Rfout(


Call:              3435   3411   3423

Dac_volt           3438   3441

Err                3441

First:             3414   3402

Freq(              3390   3405   3414   3417   3426   3429

Freqs              3390   3417   3426   3429   3432

Hilo               3390   3438

Kind$              3390   3399   3402

L_freq             3405   3417   3429   3444

Level              3438   3444

Mode               3396   3444
N_freq             3405   3414   3426   3438   3444

Next:              3426   3399
Path               3408   3420   3432   3435
Path(              3390   3408   3420   3432

Start              3390   3414   3420
```

```
3456 SUB Pset(Frq,Hi_lo,Dac_volt,Level)
3459         IF (Frq<=1) AND NOT Hi_lo THEN Range00
3462         IF (Frq<=2) AND NOT Hi_lo THEN Range0
3465         IF Frq<=4 THEN Flag=1
3468         IF (Frq>4) AND (Frq<=7.5) THEN Flag=2
3471         IF (Frq>7.5) AND (Frq<=7.8) THEN Flag=3
3472         IF (Frq>7.8) AND (Frq<8) THEN Flag=4
3477         IF (Frq>=8) AND (Frq<=10.5) THEN Flag=5
3480         IF (Frq>10.5) AND (Frq<=10.9) THEN Flag=6
3483         IF (Frq>10.9) AND (Frq<12) THEN Flag=7
3486         IF (Frq>=12) AND (Frq<14.0) THEN Flag=8
3489         IF (Frq>=14.0) AND (Frq<=15.9) THEN Flag=9
3492         IF (Frq>15.9) AND (Frq<=16.9) THEN Flag=10
3493         IF Frq>16.9 THEN Flag=11
3495         ON Flag GOTO Range1,Range2,Range3,Range4,Range5,
                          Range6,Range7,Range8,Range9,Range10,
                          Range11
3498 Range00: Dac_volt=.60
3501          Level=-5
3504   SUBEXIT
3507 Range0: Dac_volt=.55
3510         Level=-6
3513   SUBEXIT
3516 Range1: Dac_volt=.63
3519         Level=-5
3522   SUBEXIT
3525 Range2: Dac_volt=.59
3528         Level=-2
3531   SUBEXIT
3534 Range3: Dac_volt=.59
3537         Level=3
3540   SUBEXIT
3543 Range4: Dac_volt=.59
3546         Level=-18
3549   SUBEXIT
3552 Range5: Dac_volt=.59
3555         Level=-18
3558   SUBEXIT
3561 Range6: Dac_volt=.59
3564         Level=-19
3567   SUBEXIT
3570 Range7:   Dac_volt=.63
3573         Level=-15
3576   SUBEXIT
3579 Range8: Dac_volt=.63
3582         Level=-11
3585   SUBEXIT
3588 Range9: Dac_volt=.63
3591         Level=0
3594   SUBEXIT
3597 Range10: Dac_volt=.63
3598          Level=0
3600   SUBEXIT
3601 Range11: Dac_volt=.63
3602          Level=6
```

```
3603 SUBEND
3606 ! ***************** OVERLAY CALRES **********************
3609 !  FILE NAME: CALRES                  ! 810923-1330---BCY

S Pset(


Dac_volt        3456   3498   3507   3516   3525   3534   3543
                3552   3561   3570   3579   3588   3597   3601

Flag            3465   3468   3471   3472   3477   3480   3483
                3486   3489   3492   3493   3495

Frq             3456   3459   3462   3465   3468   3468   3471
                3471   3472   3472   3477   3477   3480   3480
                3483   3483   3486   3486   3489   3489   3492
                3492   3493

Hi_lo           3456   3459   3462

Level           3456   3501   3510   3519   3528   3537   3546
                3555   3564   3573   3582   3591   3598   3602

Range00:        3498   3459

Range0:         3507   3462

Range10:        3597   3495

Range11:        3601   3495

Range1:         3516   3495

Range2:         3525   3495

Range3:         3534   3495

Range4:         3543   3495

Range5:         3552   3495

Range6:         3561   3495

Range7:         3570   3495

Range8:         3579   3495

Range9:         3588   3495
```

```
3612 SUB Calres(Max_pts,Nfreqs,Repeats,Dim,Typ$,Sp,Std,Hi_lo_port,
              Prt$,Cal,Gl,Ca$)
3615 OPTION BASE 1
3618 DIM Date$[6],Time$[6],D(16,8),Id_cont$[80]
3621 DIM Freqs(Nfreqs),Power(Nfreqs,Repeats,Dim,10),File$[11],
       Dsk_nam$[11]
3624 DIM Result(Nfreqs,60),Omitf(Nfreqs),Aver(87),Var(87),
       Rd(Nfreqs,2,12)
3625  Ca$=VAL$(Cal)
3626  Freq=0
3627  DISP " "
3628   From_file$="PWR"&"D"&Ca$
3629   F_oh_file$="PWR"&"H"&Ca$
3630  PRINTER IS 16
3632   Typ=POS(Typ$,"P")
3633   Fl$=VAL$(Typ+1)
3636  IF Ca$="3" THEN From_file$="PWRD2"
3637  IF Ca$="3" THEN F_oh_file$="PWRH2"
3638  GOTO 3641
3639 ! From_file$="PWR"&"D"&Ca$
3640 ! F_oh_file$="PWR"&"H"&Ca$
3641  CALL Redhed(F_oh_file$,":F8,1",Date$,Time$,Typ$,Nfreqs,
                Freqs(*),Repeats,Sp,Std,Id_cont$,Cnnct$)
3642  FREAD From_file$&":F8,1",Power(*)
3643  IF Gl<>1 THEN GOTO 3659
3644  Fr_file$="CRST"&VAL$(VAL(Ca$)-2)
3645  PRINT Fr_file$
3646  CALL Redhed(Fr_file$,":F8,1",Date$,Time$,Typ$,Nfreqs,
                Freqs(*),Repeats,Sp,Std,Id_cont$,Cnnct$)
3647         CALL Redwrt(Fr_file$,":F8,1"," ",Result(*),Nfreqs)
3648   FOR Fr=1 TO Nfreqs
3649 FOR Sp=1 TO 2
3650 FOR P=1 TO 5
3652  ON Sp GOTO 3653,3655
3653  Rd(Fr,Sp,P)=Result(Fr,P)
3654  GOTO 3656
3655  Rd(Fr,Sp,P)=Result(Fr,P+12)
3656 NEXT P
3657 NEXT Sp
3658 NEXT Fr
3659   Dsk_nam$="SCRATCH"
3660   To_file$="CRST"&Ca$
3661   ON ERROR GOSUB Xerr
3662   ASSIGN #9 TO "T_RSLT:F8,1",Check
3663   ASSIGN * TO #9
3666   IF Check THEN CALL T_disc("T_RSLT:F8,1",4,696)
3669   OFF ERROR
3672 DISP "CALCULATING SYSTEM PARAMETERS"
3675 PRINT LIN(1);"SCRATCH DATA FILE NAME: ";From_file$
3678 PRINT LIN(1);"POWER DATA TAKEN: ";Date$&"."&Time$
3681 PRINT LIN(1);"FILE IDENTIFIER: ";Id_cont$;LIN(1)
3684 Incfrq: Freq=Freq+1
3687        IF Freq>Nfreqs THEN Done
3690         Repeat=0
3693 Incr: Repeat=Repeat+1
```

```
3696      IF Repeat>Repeats THEN Incfrq
3699       I=0
3702 Inci: I=I+1
3705      IF I>16 THEN Subr
3708       Mnt=0
3711 Incm: Mnt=Mnt+1
3714      IF Mnt>8 THEN Inci
3717       D(I,Mnt)=Power(Freq,Repeat,I,Mnt)
3720   GOTO Incm
3723 Subr: Fghz=Freqs(Freq)
3727 CALL Coeff(Freq,Fghz,Repeat,Repeats,Date$,Time$,Typ,Sp,
               From_file$,Dsk_nam$,Hi_lo_port,Prt$,Cnnct$,
               Errcnt,Error_flag,D(*),Result(*),Aver(*),Var(*),
               G1,Rd(*))
3729   GOTO Incr
3732 ! ------------------------------------------------------
3735 Done: DISP " "
3738   IF NOT Error_flag THEN 3740
3740   IF G1=1 THEN To_file$="ADP"&Ca$
3741   IF G1=1 THEN GOTO Record
3742   IF Errcnt=Nfreqs THEN Exit_flag=1
3744   IF Exit_flag THEN PRINT LIN(2);CHR$(7);"NO RESULTS SAVED
          --- PAUSE IN EFFECT"
3747   IF Exit_flag THEN PAUSE
3750   IF Exit_flag THEN Exit
3753 ! Inck: K=K+1
3756 !    IF K>Nfreqs THEN Record
3759 !    IF Omitf(K) THEN PRINT Omitf(K)
3762 ! GOTO Inck
3763 Record: IF G1=1 THEN To_file$="CRST3"
3764         CALL Wrthed((To_file$),":F8,1",Max_pts,Date$,
                        Time$,Typ$,Nfreqs,Freqs(*),Repeats,
                        Sp,Std,Id_cont$,Cnnct$)
3765         CALL Redwrt(To_file$," ",":F8,1",Result(*),Nfreqs)
3766         IF Cal=3 THEN G1=0
3767         IF Cal=2 THEN G1=0
3768        IF Cal=1 THEN G1=0
3769        IF Cal=3 THEN GOTO 3777
3770        DISP "DO YOU WISH TO RECALIBRATE THIS SET--Y/N";CHR$(7)
3771        IF FNYorn THEN GOTO 3772
3772        GOTO 3777
3773        IF Cal=3 THEN G1=1
3774        Cal=4
3775        SUBEXIT
3777        IF Cal=2 THEN G1=1
3778        IF Cal=2 THEN Cal=3
3779        IF (Cal=3) AND (G1=1) THEN GOTO 3612
3780        PRINTER IS 16
3781 Exit:  PRINT LIN(1)
3782        PRINTER IS 16
3783        DISP " "
3784        DISP "THROUGH CALCULATING  --- ";
3785         SUBEXIT
3786 SUBEND
```

```
3789 ! ****************** SUBPROGRAM COEFF *********************
3792 !   FILE NAME: COEFF                    ! 810923-1330---BCY

S Calres(


Aver(           3624   3727

Ca$             3612   3625   3628   3629   3636   3637   3644
                3660   3740

Cal             3612   3625   3766   3767   3768   3769   3773
                3774   3777   3778   3778   3779

Check           3662   3666

Cnnct$          3641   3646   3727   3764

D(              3618   3717   3727

Date$           3618   3641   3646   3678   3727   3764

Dim             3612   3621

Done:           3735   3687

Dsk_nam$        3621   3659   3727

Errcnt          3727   3742

Error_flag      3727   3738

Exit:           3781   3750

Exit_flag       3742   3744   3747   3750

Fl$             3633

F_oh_file$      3629   3637   3641

F_oh_file$:        0   3637

Fghz            3723   3727

File$           3621

Fr              3648   3653   3653   3655   3655   3658

Fr_file$        3644   3645   3646   3647

Freq            3626   3684   3684   3687   3717   3723   3727

Freqs(          3621   3641   3646   3723   3764

From_file$      3628   3636   3642   3675   3727
```

From_file$: 0 3636

Gl 3612 3643 3727 3740 3741 3763 3766
3767 3768 3773 3777 3779

Hi_lo_port 3612 3727

I 3699 3702 3702 3705 3717 3717

Id_cont$ 3618 3641 3646 3681 3764

Incfrq: 3684 3696

Inci: 3702 3714

Incm: 3711 3720

Incr: 3693 3729

Max_pts 3612 3764

Mnt 3708 3711 3711 3714 3717 3717

Nfreqs 3612 3621 3621 3624 3624 3624 3641
3646 3647 3648 3687 3742 3764 3765

Omitf(3624

P 3650 3653 3653 3655 3655 3656

Power(3621 3642 3717

Prt$ 3612 3727

Rd(3624 3653 3655 3727

Record: 3763 3741

Repeat 3690 3693 3693 3696 3717 3727

Repeats 3612 3621 3641 3646 3696 3727 3764

Result(3624 3647 3653 3655 3727 3765

Sp 3612 3641 3646 3649 3652 3653 3655
3657 3727 3764

Std 3612 3641 3646 3764

Subr: 3723 3705

Time$ 3618 3641 3646 3678 3727 3764

To_file$ 3660 3740 3740 3763 3764 3765

```
To_file$:          0   3763
Typ             3632   3633   3727
Typ$            3612   3632   3641   3646   3764
Var(            3624   3727
Xerr:              0   3661
```

```
3795 SUB Coeff(Freq,Fghz,Repeat,Repeats,Date$,Time$,Typ,Sp,
             From_file$,Dsk_nam$,Hiloport,P$,Cnnct$,Errcnt,
             Error_flag,D(*),Result(*),Aver(*),Var(*),G1,Rd(*))
3798 OPTION BASE 1
3801 DIM Wrspt(2,12),Stds(14,2),Rs(2,12),A(87),Sdev(87),S(6),
             C3(4,2),Pthru(4,8)
3804 DIM Pline(4,8),Ppad(4,8)
3807  ASSIGN #9 TO "T_RSLT:F8,1"
3810   IF Repeat=1 THEN MAT Aver=ZER
3813   IF Repeat=1 THEN MAT Var=ZER
3816   MAT Rs=ZER
3819   Date=VAL(Date$)
3822   Time=VAL(Time$)
3825   Opt$=VAL$(POS(Cnnct$,"N"))
3828   IF Opt$<>"2" THEN Calib
3831   Opt$=Opt$&Cnnct$[5]
3834 ! ------------------------------------------------------
3835 Calib:  IF G1=1 THEN Cal=1
3837        CALL Calib(D(*),Wrspt(*),Stds(*),Opt$,Error_flag,Rs(*),
                      Hiloport,G1,Rd(*),Freq)
3840       IF Error_flag THEN PRINT CHR$(7);"FATAL ERROR FOR ";
              Freqs(Freq);" GHz";LIN(1)
3843       IF Error_flag THEN Errcnt=Errcnt+1
3846       IF Error_flag THEN Omitf(Freq)=Fghz
3849       IF Error_flag THEN SUBEXIT
3852       FOR I=1 TO 4
3855       FOR J=1 TO 8
3858          Pthru(I,J)=D(I+4,J)
3861          Pline(I,J)=D(I+8,J)
3864          Ppad(I,J)=D(I+12,J)
3867       NEXT J
3870       NEXT I
3873       CALL Rhothu(Wrspt(*),Pthru(*),C3(*))
3876       FOR I=1 TO 3
3879       FOR J=1 TO 2
3882          S(2*I+J-2)=Stds(I+7,J)
3885       NEXT J
3888       NEXT I
3891       CALL Rho2pt(S(*),C3(*),Wrspt(*),Ppad(*))
3894       Stds(9,2)=S(4)
3897       MAT S=ZER
3900       S(3)=Stds(3,1)
3903       S(4)=Stds(3,2)
3906       CALL Rho2pt(S(*),C3(*),Wrspt(*),Pline(*))
3909       Stds(3,2)=S(4)
3912       Stds(3,1)=-20*LGT(Stds(3,1))
3915       Stds(9,1)=-20*LGT(Stds(9,1))
3918       Stds(11,1)=Sp
3921       Stds(11,2)=Pincid
3924       Stds(12,1)=Pstd
3927       Stds(12,2)=Pnet
3930       Stds(13,1)=Xmnt
3933       Stds(13,2)=Ymnt
3936       Many=(Repeats>1)*Repeat
3939      IF POS(P$,",") THEN PRINTER IS 7,1
```

```
3942      IF POS(P$,"0") THEN PRINTER IS 0
3945     CALL Print(Fghz,Date$,Time$,From_file$,Dsk_nam$,Stds(*),
                    Wrspt(*),Rs(*),Many,Repeats)
3948       READ #9,Repeat
3951       PRINT #9;Wrspt(*),C3(*),Stds(*),Rs(*),Fghz,Date,Time
3954 ! ------------------------------------------------------
3957      READ #9,Repeat
3960      READ #9;A(*)
3963     IF Repeat=1 THEN MAT Aver=A
3966     IF Repeats=1 THEN Prnt
3969     IF Repeat<>1 THEN CALL Avg(Aver(*),Var(*),A(*),Repeat)
3972     IF Repeat<>Repeats THEN SUBEXIT
3975       MAT Sdev=SQR(Var)
3978       PRINT #9,Repeats+1;Aver(*)
3981       READ #9,Repeats+1
3984       READ #9;Wrspt(*),C3(*),Stds(*),Rs(*),Fghz,Date,Time
3987      CALL Print(Fghz,Date$,Time$,From_file$,Dsk_nam$,Stds(*),
                     Wrspt(*),Rs(*),-1,Repeats)
3990      CALL Prnt_sdev(Fghz,Date$,Time$,From_file$,Dsk_nam$,
                         Sdev(*),Sp)
3993 Prnt: PRINTER IS 16
3996       J=0
3999 Incj: J=J+1
4002      IF J>60 THEN SUBEXIT
4005       Result(Freq,J)=Aver(J)
4008   GOTO Incj
4011 SUBEND
4014 ! ***************** SUBPROGRAM PRINT ************************
4017                                     ! 820103-1000---BCY&DHR
```

S Coeff(

A(	3801	3960	3963	3969		
Aver(	3795	3810	3963	3969	3978	4005
C3(	3801	3873	3891	3906	3951	3984
Cal	3835					
Calib:	3835	3828				
Cnnct$	3795	3825	3831			
D(	3795	3837	3858	3861	3864	
Date	3819	3951	3984			
Date$	3795	3819	3945	3987	3990	
Dsk_nam$	3795	3945	3987	3990		
Errcnt	3795	3843	3843			

Error_flag 3795 3837 3840 3843 3846 3849

Fghz 3795 3846 3945 3951 3984 3987 3990

Freq 3795 3837 3840 3846 4005

Freqs(3840

From_file$ 3795 3945 3987 3990

Gl 3795 3835 3837

Hiloport 3795 3837

I 3852 3858 3858 3861 3861 3864 3864
3870 3876 3882 3882 3888 3999 4008

J 3855 3858 3858 3861 3861 3864 3864
3867 3879 3882 3882 3885 3996 3999
3999 4002 4005 4005

Many 3936 3945

Omitf(3846

Opt$ 3825 3828 3831 3831 3837

P$ 3795 3939 3942

Pincid 3921

Pline(3804 3861 3906

Pnet 3927

Ppad(3804 3864 3891

Prnt: 3993 3966

Pstd 3924

Pthru(3801 3858 3873

Rd(3795 3837

Repeat 3795 3810 3813 3936 3948 3957 3963
3969 3969 3972

Repeats 3795 3936 3945 3966 3972 3978 3981
3987

Result(3795 4005

Rs(3801 3816 3837 3945 3951 3984 3987

S(3801 3882 3891 3894 3897 3900 3903
3906 3909

Sdev(3801 3975 3990

Sp 3795 3918 3990

Stds(3801 3837 3882 3894 3900 3903 3909
3912 3912 3915 3915 3918 3921 3924
3927 3930 3933 3945 3951 3984 3987

Time 3822 3951 3984

Time$ 3795 3822 3945 3987 3990

Typ 3795

Var(3795 3813 3969 3975

Wrspt(3801 3837 3873 3891 3906 3945 3951
3984 3987

Xmnt 3930

Ymnt 3933

```
4020 SUB Print(Fghz,Date$,Time$,File$,Dsk_nam$,Stds(*),Wrspt(*),
             Rs(*),Rpt_no,Repeat)
4023 OPTION BASE 1
4026 DIM Qpts(2,12)
4029 IF Rpt_no=0 THEN PRINT "                        SIX-PORT
                           PARAMETER RESULTS "
4032 IF Rpt_no>0 THEN PRINT "               SIX-PORT PARAMETER
                           RESULTS       REPEAT # ";Rpt_no;
                           " OF ";Repeat
4035 IF Rpt_no<0 THEN PRINT "             SIX-PORT PARAMETER
                           RESULTS     AVERAGE OF ";Repeat;
                           " REPEATS"
4038 PRINT LIN(1),"~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
~~~~~~~~~~~~~~~~~~"
4041 PRINT "YEAR  MONTH  DAY        TIME     FILE NAME    DISK
           IDENT     FREQ. IN GHz"
4044       PRINT USING Head20;Date$[1,2],Date$[3,4],Date$[5,6],
           Time$,File$,Dsk_nam$,Fghz
4047 Head20:  IMAGE X,2A,4X,2A,5X,2A,7X,6A,6X,6A,7X,7A,7X,DZ.6D
4050 PRINT LIN(1),"                     SCATTERING PARAMETERS OF
                  STANDARDS"
4053 PRINT
4056 PRINT "                   MAG--S11--ANG        dB--S12--ANG
           MAG--S22--ANG "
4059 Head51:IMAGE 11A,4X,Z.6D,2X,4D.3D,X,3D.6D,5D.3D,4X,Z.6D,2X,
           4D.3D
4062       PRINT USING Head51;"2-PORT  ",Stds(8,1),Stds(8,2),
                              Stds(9,1),Stds(9,2),Stds(10,1),
                              Stds(10,2)
4065 Head52:  IMAGE 11A,25X,Z.6D,5D.3D
4068          PRINT USING Head52;"LINE      ",Stds(3,1),Stds(3,2)
4071 Head60:  IMAGE 11A,4X,Z.6D,6D.3D
4074          PRINT USING Head60;"SHORT #1   ";Stds(4,1),Stds(4,2)
4077          PRINT USING Head60;"SHORT #2   ";Stds(5,1),Stds(5,2)
4080 Head70:  IMAGE 14A,X,Z.6D,6D.3D
4083          PRINT USING Head70;"OPEN 6-PORT #1",Stds(6,1),Stds(6,2)
4086          PRINT USING Head70;"OPEN 6-PORT #2",Stds(7,1),Stds(7,2)
4089 Head75:  IMAGE 11A,2X,3D.6D,5D.3D,18A,D,2A
4092 IF Stds(1,1)<>0 THEN PRINT USING Head75;"STD MOUNT",Stds(13,1),
     Stds(13,2),"( ON 6-PORT #",Stds(11,1)," )"
4095 Head76:  IMAGE /26A,2X,2D.4D,2X,11A
4098 Head77:  IMAGE 26A,2X,2D.4D,2X,39A
4101 IF Stds(11,1)<>0 THEN PRINT USING Head76;"STD MOUNT POWER:
                        ",Stds(12,1)," MILLIWATTS"
4104 IF Stds(11,1)<>0 THEN PRINT USING Head77;"STD MOUNT INCIDENT
     POWER: ",Stds(11,2)," MILLIWATTS"
4107 Head78: IMAGE /46A,X,Z.4D,20A,X,Z.4D
4110 IF Stds(11,1)=0 THEN PRINT USING Head78;"POWER RATIO CONSTANTS:
             6-PORT #1: (K1)=",Wrspt(1,12),"   6-PORT #2: (K2)=",
             Wrspt(2,12)
4113 IF Stds(11,1)<>0 THEN PRINT USING Head78;"POWER STANDARD CONSTANTS:  6-PORT
 #1: (K1)=",Wrspt(1,12),"    6-PORT #2: (K2)=",Wrspt(2,12)
4116          PRINT
4119          GOSUB Qprint
4122          PRINT "~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~"
```

```
4125  PRINT "RMS PARABOLOID RES*1E6 |  ***    CIRCLE RESIDUALS*1E6
              *** |  2-PORT RES*1E6"
4128  PRINT "          INITIAL FINAL| SHORT  OPEN  THRU  LINE  2-
            PORT AVG | THRU  LINE 2-PORT"
4131  MAT Rs=Rs*(1E6)
4134 Head_res:  IMAGE 9A,X,2(6D),X,A,4(5D,X),2X,2(5D),2A,3(5D,X)
4137 Head_res1:  IMAGE 9A, X,2(6D),X,A,4(5D,X),2X,2(5D),2A
4140 PRINT USING Head_res;"6-PORT #1",Rs(1,1)*(Rs(1,2)/1E6),Rs(1,1),
          "|",Rs(1,3),Rs(1,4),Rs(1,5),Rs(1,6),Rs(1,7),Rs(1,8)," |",
           Rs(1,9),Rs(1,10),Rs(1,11)
4143 PRINT USING Head_res1;"6-PORT #2",Rs(2,1)*(Rs(2,2)/1E6),Rs(2,1),
          "|",Rs(2,3),Rs(2,4),Rs(2,5),Rs(2,6),Rs(2,7),Rs(2,8)," |"
4146          PRINT "~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
                     ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~"
4149  MAT Rs=Rs/(1E6)
4152 SUBEND
4155 Qprint: !
4158   CALL Wq(Wrspt(*),Qpts(*))          ! Calculate Q points
4161   PRINT "                  Q-POINT DESCRIPTION OF SIX-PORTS"
4164   PRINT
4167 PRINT USING Qpts1;"              MAG-1/Q1-ANG"
4170 Qpts1: IMAGE 25A,"     MAG--Q2--ANG     MAG--Q3--ANG
                        MAG--Q4--ANG"
4173 PRINT USING Qpts2;1,Qpts(1,1),Qpts(1,2),Qpts(1,3),Qpts(1,4),
                Qpts(1,5),Qpts(1,6),Qpts(1,7),Qpts(1,8)
4176 PRINT USING Qpts2;2,Qpts(2,1),Qpts(2,2),Qpts(2,3),Qpts(2,4),
                Qpts(2,5),Qpts(2,6),Qpts(2,7),Qpts(2,8)
4179 Qpts2:  IMAGE "6-PORT #"D,X,4(2X,Z.4D,X,4D.3D)
4182 PRINT
4185 RETURN
4188 ! ********** SUBROUTINE PRINT STD DEVIATIONS ****************
4191 !  820103-0900---BCY&DHR

S Print(


Date$              4020   4044   4044   4044

Dsk_nam$           4020   4044

Fghz               4020   4044

File$              4020   4044

Head20:            4047

Head51:            4059

Head52:            4065

Head60:            4071

Head70:            4080

Head75:            4089
```

```
Head76:          4095

Head77:          4098

Head78:          4107

Head_res1:       4137

Head_res:        4134

Qprint:          4155   4119

Qpts(            4026   4158   4173   4173   4173   4173   4173
                 4173   4173   4173   4176   4176   4176   4176
                 4176   4176   4176   4176

Qpts1:           4170

Qpts2:           4179

Repeat           4020   4032   4035

Rpt_no           4020   4029   4032   4032   4035

Rs(              4020   4131   4131   4140   4140   4140   4140
                 4140   4140   4140   4140   4140   4140   4140
                 4140   4143   4143   4143   4143   4143   4143
                 4143   4143   4143   4149   4149

Stds(            4020   4062   4062   4062   4062   4062   4062
                 4068   4068   4074   4074   4077   4077   4083
                 4083   4086   4086   4092   4092   4092   4092
                 4101   4101   4104   4104   4110   4113

Time$            4020   4044

Wrspt(           4020   4110   4110   4113   4113   4158
```

```
4194 SUB Prnt_sdev(Fghz,Date$,Time$,File$,Dsk_nam$,Sdev(*),Sp)
4197 OPTION BASE 1
4200 PRINT LIN(2);"   STANDARD DEVIATIONS OF SELECTED PARAMETER
                  RESULTS"
4203   PRINT LIN(1);"~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
                    ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~"
4206 PRINT "YEAR  MONTH  DAY        TIME     FILE NAME    DISK
           IDENT     FREQ. IN GHz"
4209          PRINT USING Head2;Date$[1,2],Date$[3,4],Date$[5,6],
                                Time$,File$,Dsk_nam$,Fghz
4212 Head2:  IMAGE X,2A,4X,2A,5X,2A,7X,6A,6X,6A,7X,7A,7X,DZ.6D
4215 PRINT LIN(1),"                    SCATTERING PARAMETERS OF
                  STANDARDS"
4218 PRINT
4221 PRINT "                   MAG--S11             dB--S12
                     MAG--S22"
4224 Head3:  IMAGE 11A,7X,Z.6D,12X,Z.6D,14X,Z.6D
4227          PRINT USING Head3;"2-PORT     ",Sdev(37),Sdev(39),
                  Sdev(41)
4230 Head4:  IMAGE 11A,27X,Z.6D
4233          PRINT USING Head4;"LINE       ",Sdev(29)
4236 Head5:  IMAGE 15A,3X,Z.6D
4239          PRINT USING Head5;"SHORT      ",Sdev(31)
4242          PRINT USING Head5;"OPEN 6-PORT #1 ",Sdev(33)
4245          PRINT USING Head5;"OPEN 6-PORT #2 ",Sdev(35)
4248 Head7:  IMAGE 11A,8X,.6D,8X,17A,D,2A
4251   IF Sp<>0 THEN PRINT USING Head7;"STD MOUNT  ",Sdev(49),
                         "    ( on 6-PORT #",Sp," )"
4254 Head8:  IMAGE /26A,4X,.4D,2X,11A
4257 Head9:  IMAGE 26A,4X,.4D,2X,39A
4260 IF Sp<>0 THEN PRINT USING Head8;"STD MOUNT POWER:          ",
                  Sdev(37)," MILLIWATTS"
4263 IF Sp<>0 THEN PRINT USING Head9;"STD MOUNT INCIDENT POWER: ",
                  Sdev(36)," MILIWATTS"
4266 Head10: IMAGE /46A,X,Z.4D,19A,X,Z.4D
4269 IF Sp=0 THEN PRINT USING Head10;"POWER RATIO CONSTANTS:
                          6-PORT #1: (K1)=",Sdev(12),"
                          6-PORT #2: (K2)=",Sdev(24)
4272 IF Sp<>0 THEN PRINT USING Head10;"POWER CALIBRATION
                  CONSTANTS:  6-PORT #1: (K1)=",Sdev(12),"
                  6-PORT #2: (K2)=",Sdev(24)
4275 PRINT CHR$(12)
4278 SUBEND
4281 ! ************* SUBROUTINE RHOTHU ************************
4284 ! FILE NAME:  RHOTHU                  ! 830310-1100---BCY

S Prnt_sdev(


Date$            4194   4209   4209   4209

Dsk_nam$         4194   4209

Fghz             4194   4209
```

File$	4194	4209					
Head10:	4266						
Head2:	4212						
Head3:	4224						
Head4:	4230						
Head5:	4236						
Head7:	4248						
Head8:	4254						
Head9:	4257						
Sdev(	4194	4227	4227	4227	4233	4239	4242
	4245	4251	4260	4263	4269	4269	4272
	4272						
Sp	4194	4251	4251	4260	4263	4269	4272
Time$	4194	4209					

```
4287 SUB Rhothu(Wrspt(*),Pthru(*),C3(*))
4290  OPTION BASE 1
4293  DIM W(4,8),Rthru(4,4)
4296  DEG
4299  FOR I=1 TO 4
4302     CALL W(Pthru(*),1,4,0,1,Wrspt(*),W(*))
4305     CALL Wg(Wrspt(*),1,0,W(I,1),W(I,2),Rthru(I,1),Rthru(I,2))
4308     C3(I,2)=Argth=ATN(Rthru(I,2)/(Rthru(I,1)+1E-20))+180*
         (Rthru(I,1)<0)*SGN(Rthru(I,2)+1E-20)
4311     C3(I,1)=Magth=SQR(Rthru(I,1)^2+Rthru(I,2)^2)
4314   NEXT I
4317   SUBEND
4320 ! ********** SUBROUTINE RHO2PT ***************************
4323 ! FILE NAME: RHO2PT                    ! 830311-1130---BCY

S Rhothu(


Argth            4308

C3(              4287   4308   4311

I                4299   4305   4305   4305   4305   4308   4308
                 4308   4308   4308   4311   4311   4311   4314

Magth            4311

Pthru(           4287   4302

Rthru(           4293   4305   4305   4308   4308   4308   4308
                 4311   4311

W(               4293   4302   4305   4305

Wrspt(           4287   4302   4305
```

```
4326 SUB Rho2pt(S(*),C3(*),Wrspt(*),P2pt(*))
4329  OPTION BASE 1
4332  DIM G(4,4),W(4,8)
4335  DEG
4338  I=1
4341     Argth=C3(I,2)
4344     CALL W(P2pt(*),1,4,0,1,Wrspt(*),W(*))
4347     CALL Wg(Wrspt(*),1,0,W(I,1),W(I,2),G(I,1),G(I,2))
4350     CALL Rect(S(1),S(2),X1,Y1)
4353     CALL Csub(G(I,1),G(I,2),X1,Y1,X,Y)
4356     Arg2p=ATN(Y/(X+1E-20))+180*(X<0)*SGN(Y+1E-20)
4359     Arg12=Arg2p-Argth
4362 Test:IF ABS(Arg12)<180 THEN Skp
4365       Arg12=Arg12-SGN(Arg12)*360
4368 GOTO Test
4371 Skp:  Args4=S(4)
4374       Sgn12=SGN(Arg12)*1
4377       Sgns4=SGN(Args4)*1
4380      IF Sgn12=Sgns4 THEN Subt
4383       Args4=Args4-SGN(Args4)*180
4386      IF ABS(Arg12-Args4)<90 THEN Switch
4389 Subt: IF ABS(Arg12-Args4)<90 THEN Exit
4392 Switch: S(4)=S(4)-SGN(S(4))*180
4395 Exit:SUBEND
4398 ! ********* SUBPROGRAM DISC COPY *****************
4401 !  FILE NAME:   DCOPY ! 820116-0110---BCY

S Rho2pt(


Arg12             4359   4362   4365   4365   4365   4374   4386
                  4389

Arg2p             4356   4359

Args4             4371   4377   4383   4383   4383   4386   4389

Argth             4341   4359

C3(               4326   4341

Exit:             4395   4389

G(                4332   4347   4347   4353   4353

I                 4338   4341   4347   4347   4347   4347   4353
                  4353

P2pt(             4326   4344

S(                4326   4350   4350   4371   4392   4392   4392

Sgn12             4374   4380

Sgns4             4377   4380
```

Skp: 4371 4362

Subt: 4389 4380

Switch: 4392 4386

Test: 4362 4368

W(4332 4344 4347 4347

Wrspt(4326 4344 4347

X 4353 4356 4356

X1 4350 4353

Y 4353 4356 4356

Y1 4350 4353

```
4404 SUB Disc_copy(Fil_nam$,Nfreqs,Typ$,Ca$)
4407 OPTION BASE 1
4410 DIM Date$[6],Time$[6]
4413 DIM Freqs(Nfreqs),Id_content$[80],Result(Nfreqs,52)
4416 Fl$=VAL$(POS(Typ$,"P")+1)
4419   CALL Redhed("CRST"&Ca$,":F8,1",Date$,Time$,Typ$,Nfreqs,
                   Freqs(*),Repeats,Sp,Std,Id_content$,Cnnct$)
4422   CALL Redwrt("CRST"&Ca$,":F8,1"," ",Result(*),Nfreqs)
4425   CALL Wrthed(Fil_nam$,":F8,0",Nfreqs,Date$,Time$,Typ$,
                  Nfreqs,Freqs(*),Repeats,Sp,Std,Id_content$,
                  Cnnct$)
4428   CALL Redwrt(Fil_nam$," ",":F8,0",Result(*),Nfreqs)
4431 SUBEND
4434 ! *************** SUBPROGRAM DISC TRANS *****************
4437 !  FILE NAME:   DTRANS                !820116-0120---BCY

S Disc_copy(

Ca$              4404   4419   4422

Cnnct$           4419   4425

Date$            4410   4419   4425

Fl$              4416

Fil_nam$         4404   4425   4428

Freqs(           4413   4419   4425

Id_content$      4413   4419   4425

Nfreqs           4404   4413   4413   4419   4422   4425   4425
                 4428

Repeats          4419   4425

Result(          4413   4422   4428

Sp               4419   4425

Std              4419   4425

Time$            4410   4419   4425

Typ$             4404   4416   4419   4425
```

```
4440 SUB Disc_trans(Fil_nam$,Records,Nfreqs)
4443 OPTION BASE 1
4446 DIM Date$[6],Time$[6],Typ$[6]
4449 DIM Freqs(Nfreqs),Id_content$[80],Result(Nfreqs,52)
4452   CALL Redhed(Fil_nam$,":F8,0",Date$,Time$,Typ$,Nfreqs,
                   Freqs(*),Repeats,Sp,Std,Id_content$,Cnnct$)
4455   CALL Redwrt(Fil_nam$,":F8,0"," ",Result(*),Nfreqs)
4458  Fl$=VAL$(POS(Typ$,"P")+1)
4461   CALL Wrthed("CRST"&Ca$,":F8,1",Records,Date$,Time$,Typ$,
                   Nfreqs,Freqs(*),Repeats,Sp,Std,Id_content$,
                   Cnnct$)
4464   CALL Redwrt("CRST"&Ca$," ",":F8,1",Result(*),Nfreqs)
4467   PRINT LIN(5);Fil_nam$;" CALIBRATION DATA TAKEN ON ";Date$
4470   PRINT LIN(2);"FREQUENCIES AT (GHZ)"
4473   PRINT
4476   FOR I=1 TO Nfreqs
4479      PRINT Freqs(I)
4482   NEXT I
4485 SUBEND
4488 ! ************ SUBPROGRAM WRTHED ************************
4491 ! FILE NAME:  WRTHED                    ! 820106-0800---BCY

S Disc_trans(

Ca$              4461   4464

Cnnct$           4452   4461

Date$            4446   4452   4461   4467

Fl$              4458

Fil_nam$         4440   4452   4455   4467

Freqs(           4449   4452   4461   4479

I                4476   4479   4482

Id_content$      4449   4452   4461

Nfreqs           4440   4449   4449   4452   4455   4461   4464
                 4476

Records          4440   4461

Repeats          4452   4461

Result(          4449   4455   4464

Sp               4452   4461

Std              4452   4461
Time$            4446   4452   4461
Typ$             4446   4452   4458   4461
```

```
4494 SUB Wrthed(File$,Msu$,Records,Date$,Time$,Typ$,Nfreqs,
               Freq_o(*),Repeats,Sp,Std_mnt,Id_content$,
               Cnnct$)
4497 OPTION BASE 1
4500 DIM Id$[19],Overhead$[80]
4503 MASS STORAGE IS Msu$
4504  PRINT File$
4505  WAIT 2500
4506 Overhead$="R2: 9 strings. R3: 4 strings, 4 real. R4:
               2 strings[80]. R5&R6: array(Nfreqs)"
4509 Id$="IDENTIFIER STRING: "
4512 Retry:  DISP " "
4515         PRINT CHR$(12)
4518 !      ON ERROR GOTO Trap
4521         ASSIGN #1 TO File$,Check
4524         ASSIGN * TO #1
4527        IF Check THEN CREATE File$,6+2*Records
4530          ASSIGN #1 TO File$
4533          PRINT #1,1;Overhead$
4536          PRINT #1,2;"DATE$","TIME$","TYP$","CNNCT","NFREQS",
                    "REPEATS","6-PORT","STD MNT","FREQUENCIES"
4539          PRINT #1,3;Date$,Time$,Typ$,Cnnct$,Nfreqs,Repeats,
                        Sp,Std_mnt
4542          PRINT #1,4;Id$,Id_content$
4545          READ #1,5
4548          PRINT #1;Freq_o(*)
4551          ASSIGN * TO #1
4554          OFF ERROR
4557  SUBEXIT
4560 Trap:    OFF ERROR
4563         IF FNDerr(ERRM$) THEN Retry
4566 SUBEND
4569 ! ************ SUBPROGRAM REDHED ***************************
4572 ! FILE NAME:  REDHED                    ! 820106-0730---BCY
```

```
S Wrthed(


Check             4521   4527

Cnnct$            4494   4539

Date$             4494   4539

File$             4494   4504   4521   4527   4530

Freq_o(           4494   4548

Id$               4500   4509   4542

Id_content$       4494   4542

Msu$              4494   4503

Nfreqs            4494   4539
```

Overhead$	4500	4506	4533
Records	4494	4527	
Repeats	4494	4539	
Retry:	4512	4563	
Sp	4494	4539	
Std_mnt	4494	4539	
Time$	4494	4539	
Trap:	4560		
Typ$	4494	4539	

```
4575 SUB Redhed(File$,Msu$,Date$,Time$,Typ$,Nfreqs,Freq_o(*),
               Repeats,Sp,Std_mnt,Id_content$,Cnnct$)
4578 OPTION BASE 1
4581 DIM Id$[19],Overhead$[80],Form$(8)[11]
4584 MASS STORAGE IS Msu$
4585  PRINT File$
4586  WAIT 2500
4587 Retry:   DISP " "
4590          PRINT CHR$(12)
4593  !       ON ERROR GOTO Trap
4596          ASSIGN #1 TO File$
4599          READ #1,1;Overhead$
4602          READ #1,2;Form$(*)
4605          READ #1,3;Date$,Time$,Typ$,Cnnct$,Nfreqs,Repeats,
                   Sp,Std_mnt
4608          READ #1,4;Id$,Id_content$
4611          READ #1,5
4614          READ #1;Freq_o(*)
4617          ASSIGN * TO #1
4620          OFF ERROR
4623  SUBEXIT
4626 Trap:    OFF ERROR
4627  PRINT Files$
4629         IF FNDerr(ERRM$) THEN Retry
4632 SUBEND
4635 ! ************ SUBPROGRAM WRTBIN ******************
4638 ! FILE NAME:  WRTBIN              ! 811217-1500---BCY

S Redhed(


Cnnct$            4575   4605

Date$             4575   4605

File$             4575   4585   4596

Files$            4627

Form$(            4581   4602

Freq_o(           4575   4614

Id$               4581   4608

Id_content$       4575   4608

Msu$              4575   4584

Nfreqs            4575   4605

Overhead$         4581   4599

Repeats           4575   4605
```

Retry: 4587 4629

Sp 4575 4605

Std_mnt 4575 4605

Time$ 4575 4605

Trap: 4626

Typ$ 4575 4605

```
4641 SUB Wrtbin(File$,Msu$,File(*),Records)
4644 OPTION BASE 1
4647 MASS STORAGE IS Msu$
4650 Retry:   DISP " "
4653          PRINT CHR$(12)
4656          ON ERROR GOTO Trap
4659          FCREATE File$,Records
4662 Fprint:  FPRINT File$,File(*)
4665          OFF ERROR
4668  SUBEXIT
4671 Trap:    OFF ERROR
4674         IF ERRN=54 THEN Fprint
4677         IF FNDerr(ERRM$) THEN Retry
4680 SUBEND
4683 ! ***************** SUBPROGRAM REDWRT ***********************
4686 !  FILE NAME:  REDWRT                      ! 820116-1230---BCY

S Wrtbin(


File$             4641   4659   4662

File(             4641   4662

Fprint:           4662   4674

Msu$              4641   4647

Records           4641   4659

Retry:            4650   4677

Trap:             4671   4656
```

```
4689 SUB Redwrt(File$,From$,To$,Data(*),Nfreqs)
4692 OPTION BASE 1
4695 Start:  PRINT CHR$(12)
4698         DISP " "
4701 !       ON ERROR GOTO Trap
4704         ASSIGN #1 TO File$
4707        IF To$=" " THEN Read
4710       MASS STORAGE IS To$
4713 Inci: I=I+1
4716      IF I>Nfreqs THEN Exit
4719       READ #1,5+2*I
4722       J=0
4725 Incj: J=J+1
4728      IF J>52 THEN Inci
4731       PRINT #1;Data(I,J)
4734   GOTO Incj
4737 Read: MASS STORAGE IS From$
4740 Inc_i: I=I+1
4743       IF I>Nfreqs THEN Exit
4746        READ #1,5+2*I
4749        J=0
4752 Inc_j: J=J+1
4755       IF J>52 THEN Inc_i
4758        READ #1;Data(I,J)
4761   GOTO Inc_j
4764 Exit: ASSIGN * TO #1
4767       OFF ERROR
4770  SUBEXIT
4773 Trap: OFF ERROR
4776      IF FNDerr(ERRM$) THEN Start
4779 SUBEND
4782 ! ********** FUNCTION FNDERR ****************
4785 !  FILE NAME:  FNDERR       ! 820127-1745---BCY
```

```
S Redwrt(


Data(             4689   4731   4758

Exit:             4764   4716   4743

File$             4689   4704

From$             4689   4737

I                 4713   4713   4716   4719   4731   4740   4740
                  4743   4746   4758

Inc_i:            4740   4755

Inc_j:            4752   4761

Inci:             4713   4728

Incj:             4725   4734
```

J 4722 4725 4725 4728 4731 4749 4752
4752 4755 4758

Nfreqs 4689 4716 4743

Read: 4737 4707

Start: 4695 4776

To$ 4689 4707 4710

Trap: 4773

```
4788  DEF FNDerr(Errm$)
4791  PRINT LIN(10);ERRM$
4794  DISP "DO YOU WANT TO RETRY ? -- (Y/N)";CHR$(7);
4797  IF FNYorn THEN RETURN 1
4800  PRINT CHR$(12);LIN(15);CHR$(7);"FATAL ERROR --- PROGRAM
            HALT"
4803   DISP " "
4806   STOP
4809  RETURN 0
4812  FNEND
4815 ! ***************** SUBROUTINE T_DISC **********************
4818 !  FILE NAME: T_DISC                    ! 810818-1600---BCY

FNDerr(


Errm$             4788
```

```
4821 SUB T_disc(File$,Records,Length)
4824    ON ERROR GOTO Errml
4827   CREATE File$,Records,Length
4830   SUBEXIT
4833 Errml:   PRINT ERRM$
4836          PRINT "PAUSE IN EFFECT"
4839          PAUSE
4842          BEEP
4845   SUBEND
4848 ! ********************************************************

S T_disc(


Errml:            4833   4824

File$             4821   4827

Length            4821   4827

Records           4821   4827
```

```
4851 SUB Wrp(Wr(*),Wp(*)) ! Converts Wrspt to polar form
4854 MAT Wp=Wr
4857 FOR I=1 TO 2
4860 FOR J=4 TO 10 STEP 2
4863 CALL Polar(Wr(I,J),Wr(I,J+1),Wp(I,J),Wp(I,J+1))
4866 NEXT J
4869 NEXT I
4872 SUBEND
4875 ! ********** CALIB **********************************

S Wrp(


Calib:          4878

I               4857   4863   4863   4863   4863   4869

J               4860   4863   4863   4863   4863   4866

Wp(             4851   4854   4863   4863

Wr(             4851   4854   4863   4863
```

```
4878 Calib: SUB Calib(Pwr(*),Wrspt(*),Stds(*),Opt$,Error_flag,
                    Resid(*),Hi_lo_port,Gl,Rd(*),Freq)
                    !----(81/07/31)----GFE-GEC-------
4881 OPTION BASE 1
4884 DIM V(1:5),W(1:16,1:8),Res(2,12)
4887 MAT Resid=ZER                          ! Cres is NIOSH CR record 7   p. 5-10
4890 MAT Res=ZER                            ! Cres is NIOSH               p. 6-24
4893 Error_flag=0              ! Nonzero if calculation error, >0 if fatal error
4896 IF Gl=1 THEN GOTO 4912
4897 FOR Sp=1 TO 2
4899    CALL Iparab(Pwr(*),Sp,V(*),Error_flag)
4902    IF Error_flag>0 THEN GOTO Calib_exit
4905    CALL Fparab(Pwr(*),Sp,V(*),Wrspt(*),Res(*),Error_flag,Hi_lo_port)
4908    IF Error_flag>0 THEN GOTO Calib_exit
4910 NEXT Sp
4911  GOTO 4921
4912  ! CONT
4916  FOR P=1 TO 5
4917  FOR Sp=1 TO 2
4918  Wrspt(Sp,P)=Rd(Freq,Sp,P)
4919  NEXT Sp
4920  NEXT P
4921  !
4923 ! PRINT Wrspt(1,1),Wrspt(1,2),Wrspt(1,3),Wrspt(1,4),
            Wrspt(1,5)
4924 CALL W(Pwr(*),1,16,16,1,Wrspt(*),W(*))
4925 FOR I=1 TO 2
4926    Res(I,3)=W(3,4*I)
4927    Res(I,4)=W(4,4*I)
4928    FOR J=5 TO 7
4929       FOR K=4*J-15 TO 4*J-12
4932          Res(I,J)=Res(I,J)+W(K,4*I)/4
4935       NEXT K
4938    NEXT J
4941 NEXT I
4944 CALL Tr15(W(*),Wrspt(*),Opt$,Stds(*),Res(*))
4947 CALL Stds2(W(*),Wrspt(*),Stds(*),Res(*))
4950 CALL Pratio(W(*),5,Wrspt(*),Wrspt(2,12))
4953    Wrspt(1,12)=1
4956    Res(1,8)=(Res(1,3)+Res(1,4)+4*Res(1,5)+4*Res(1,6)
                  +4*Res(1,7))/14
4959    Res(2,8)=(Res(2,3)+Res(2,4)+4*Res(2,5)+4*Res(2,6)
                  +4*Res(2,7))/14
4962    MAT Resid=Res
4965 Calib_exit: SUBEND
4968 ! ************************************
```

```
S Calib(


Calib_exit:       4965   4902   4908

Error_flag        4878   4893   4899   4902   4905   4908

Freq              4878   4918
```

Gl 4878 4896

Hi_lo_port 4878 4905

I 4925 4926 4926 4927 4927 4932 4932
4932 4941

J 4928 4929 4929 4932 4932 4938

K 4929 4932 4935

Opt$ 4878 4944

P 4916 4918 4918 4920

Pwr(4878 4899 4905 4924

Rd(4878 4918

Res(4884 4890 4905 4926 4927 4932 4932
4944 4947 4956 4956 4956 4956 4956
4956 4959 4959 4959 4959 4959 4959
4962

Resid(4878 4887 4962

Sp 4897 4899 4905 4910 4917 4918 4918
4919

Stds(4878 4944 4947

V(4884 4899 4905

W(4884 4924 4926 4927 4932 4944 4947
4950

Wrspt(4878 4905 4918 4924 4944 4947 4950
4950 4953

```
4971 SUB Iparab(P(*),Sp,V(*),Error_flag)  !--(81/07/30)-GFE-GEC-
4974 ON ERROR GOTO Error
4977 DIM B(1:16,1:9),X(1:9),Y(1:16)
4980 MAT Y=(-1)
4983 K=4*Sp-4    ! Adds 4 to column index when Sp=2
4986 N=0
4989 FOR J=1 TO 16  ! Iterate over rows in "P" matrix
4992 I=J-N          ! Index for "B" matrix
4995 P=P(J,K+1)
4998 IF P>0 THEN B      ! P=0 indicates no data in this row:
                          skip to next one
5001 N=N+1              ! & adjust row index for MAT "B" to lag
                         "P" by one unit
5004 GOTO Nextj
5007 B: B(I,7)=A=P(J,K+2)/P
5010    B(I,8)=B=P(J,K+3)/P
5013    B(I,9)=C=P(J,K+4)/P
5016    B(I,1)=A*A
5019    B(I,2)=B*B
5022    B(I,3)=C*C
5025    B(I,4)=A*B
5028    B(I,5)=A*C
5031    B(I,6)=B*C
5034 Nextj: NEXT J
5037 REDIM B(1:I,1:9),Y(1:I)  ! Drop last N rows in "B" and "Y",
                                (no data here)
5040 CALL Msoln(B(*),Y(*),X(*))
5043 B=(2*X(4)-X(7)*X(8))/(2*X(1)*X(8)-X(4)*X(7))
5046 C=(2*X(5)-X(7)*X(9))/(2*X(1)*X(9)-X(5)*X(7))
5049 A=B+C+X(7)/X(1)
5052 V(1)=R1=SQR(X(2)*A*C)
5055 V(2)=R2=SQR(X(3)*A*B)
5058 V(3)=W1=SQR(C)
5061 V(4)=W2=(B+C-A)/2/W1
5064 V(5)=W3=B-W2*W2
5067 SUBEXIT
5070 Error: BEEP
5073 IF ERRN=30 THEN PRINT "Failure in Iparab, Poor set of power
                           data indicated.
   Sp= ";Sp
5076 IF ERRN<>30 THEN PRINT ERRM$
5079 Error_flag=10
5082 SUBEND
5085 ! ********************************************************

S Iparab(


A                5007   5016   5016   5025   5028   5049   5052
                 5055   5061

B                5010   5019   5019   5025   5031   5043   5049
                 5055   5061   5064

B(               4977   5007   5010   5013   5016   5019   5022
```

	5025	5028	5031	5037	5040		
B:	5007	4998					
C	5013	5022	5022	5028	5031	5046	5049
	5052	5058	5061				
Error:	5070	4974					
Error_flag	4971	5079					
Fparab:	5088						
I	4992	5007	5010	5013	5016	5019	5022
	5025	5028	5031	5037	5037	4989	4992
	4995	5007	5010	5013	5034	4983	4995
	5007	5010	5013				
N	4986	4992	5001	5001			
Nextj:	5034	5004					
P	4995	4998	5007	5010	5013		
P(	4971	4995	5007	5010	5013		
R1	5052						
R2	5055						
Sp	4971	4983	5073				
V(	4971	5052	5055	5058	5061	5064	
W1	5058	5061					
W2	5061	5064	5064				
W3	5064						
X(	4977	5040	5043	5043	5043	5043	5043
	5043	5043	5046	5046	5046	5046	5046
	5046	5046	5049	5049	5052	5055	
Y(	4977	4980	5037	5040			

```
5088 Fparab: SUB Fparab(P(*),Sp,V(*),W(*),Res(*),Error_flag,Hi_lo
                      _port)
   ! --(81/07/30)----------GFE-GEC-------
5091 ! V(1)...V(5)=R1,R2,W1,W2,W3
5094 DIM B(1:16,1:5),X(1:5),Y(1:16)
5097 K=4*Sp-4           ! Adds 4 to column index when Sp=2
5100 Ab=(V(4)*V(4)+V(5))*((V(4)-V(3))^2+V(5))  ! Normalize by ab
5103 FOR H=1 TO 10    ! 10 = upper limit to number of iterations
5106 N: N=0
5109 FOR J=1 TO 16      ! Iterates over rows in "P" matrix
5112 I=J-N              ! Index for "B" matrix
5115 P=P(J,K+1)
5118 IF P>0 THEN P      ! P=0 indicates no data in this row:
                          skip to next one
5121 N=N+1              ! & adjust row index in MAT "B" to lag "P"
                          by one unit
5124 GOTO Nextj
5127 P: P3=P(J,K+2)/P
5130    P5=P(J,K+3)/P
5133    P6=P(J,K+4)/P
5136    A=(V(1)*P5-P3)/V(3)-V(3)
5139    B=P3+V(4)*(V(4)+A)+V(5)-V(2)*P6
5142    C=A*A-4*P3
5145    P=2*(B*V(4)+A*V(5))
5148    Y(I)=-B*B-C*V(5)
5151 !  Parab_res(Sp,J)=Y(I)/Ab !Place normalized residual in
                                 approprate column
5154    B(I,1)=P*P5/V(3)
5157    B(I,2)=-2*B*P6
5160    B(I,3)=P*(-A/V(3)-2)
5163    B(I,4)=2*B*(2*V(4)+A)
5166    B(I,5)=2*B+C
5169 Nextj: NEXT J
5172 REDIM B(1:I,1:5),Y(1:I)    ! Drop bottom N rows (no data here)
5175 Q=DOT(Y,Y)
5178 IF H>1 THEN Qa
5181 Qi=Q                       ! Save initial residual
5184 GOTO T                     ! Initialize T
5187 Qa: IF Q<T*1.001 THEN Qb
5190 L=2*L
5193 IF L>70 THEN Error_flag=2
5196 IF L>70 THEN Error
5199 MAT X=X/(L)
5202 MAT V=V-X
5205 GOTO N
5208 Qb: IF (Q>T*.99) OR (Q<1E-16) THEN Res
                              !  "Normal" exit from "Fparab"
5211 T: T=Q
5214 L=1
5217 CALL Msoln(B(*),Y(*),X(*))
5220 MAT V=V+X
5223 NEXT H
5226 PRINT "Ten iterations performed by Fparab"
5229 Error_flag=1
5232 Error: BEEP
```

```
5235 PRINT "Abnormal exit from Fparab routine. Poor initial
          estimate implied"
5238 Res: Ab=(V(4)*V(4)+V(5))*((V(4)-V(3))^2+V(5))
                                  ! Normalize by  ab
5241      Res(Sp,1)=SQR(Q/(I-5))/Ab
5244      Res(Sp,2)=SQR(Qi/Q)
5247 IF V(5)>0 THEN Ex
5250 PRINT "Error in Fparab, (Im(W2))^2= ";V(5)
5253 V5=SQR(ABS(V(5)))
5256 Error_flag=Error_flag+2
5259 GOTO Err
5262 Ex: V(5)=SQR(V(5))   ! A plus or minus sign may be required
                            depending upon
5265 IF NOT Hi_lo_port THEN V(5)=-V(5)
5268 IF ABS(V(5)/V(4))>.05 THEN Exit
     !      how detector "numbers" are assigned
5271 BEEP
5274 PRINT "Poor initial parabolid estimate indicated"
5277 PRINT
5280 Err: BEEP
5283 PRINT "Six-port=";Sp
5286 PRINT "Zeta=    ";V(1)
5289 PRINT "Rho=     ";V(2)
5292 PRINT "Wl=      ";V(3)
5295 PRINT "Re(W2)=  ";V(4)
5298 PRINT "Im(W2)=  ";V(5)
5301 PAUSE
5304 Exit: FOR I=1 TO 5
5307 W(Sp,I)=V(I)
5310 NEXT I
5313 SUBEND
5316 ! ***************************
S Fparab(


A               5136   5139   5142   5142   5145   5160   5163

Ab              5100   5238   5241

B               5139   5145   5148   5148   5157   5163   5166

B(              5094   5154   5157   5160   5163   5166   5172
                5217

C               5142   5148   5166

Err:            5280   5259

Error:          5232   5196

Error_flag      5088   5193   5229   5256   5256

Ex:             5262   5247

Exit:           5304   5268
```

H 5103 5178 5223

Hi_lo_port 5088 5265

I 5112 5148 5154 5157 5160 5163 5166
5172 5172 5241 5304 5307 5307 5310

J 5109 5112 5115 5127 5130 5133 5169

K 5097 5115 5127 5130 5133

L 5190 5190 5193 5196 5199 5214

N 5106 5112 5121 5121

N: 5106 5205

Nextj: 5169 5124

P 5115 5118 5127 5130 5133 5145 5154
5160

P(5088 5115 5127 5130 5133

P3 5127 5136 5139 5142

P5 5130 5136 5154

P6 5133 5139 5157

P: 5127 5118

Q 5175 5181 5187 5208 5208 5211 5241
5244

Qa: 5187 5178

Qb: 5208 5187

Qi 5181 5244

Res(5088 5241 5244

Res: 5238 5208

Sp 5088 5097 5241 5244 5283 5307

T 5187 5208 5211

T: 5211 5184

V(5088 5100 5100 5100 5100 5100 5100
5136 5136 5136 5139 5139 5139 5139
5145 5145 5148 5154 5160 5163 5202

	5202	5220	5220	5238	5238	5238	5238
	5238	5238	5247	5250	5253	5262	5262
	5265	5265	5268	5268	5286	5289	5292
	5295	5298	5307				
V5	5253						
W(	5088	5307					
X(	5094	5199	5199	5202	5217	5220	
Y	5175						
Y(	5094	5148	5172	5175	5217		

```
5319 SUB Pratio(W(*),Row,Wr(*),R) ! -(81/05/06)-GFE--
5322 DIM A(1:8)
5325 FOR I=1 TO 4
5328 J=Row+I-1
5331 CALL Cmpy(Wr(1,10),Wr(1,11),W(J,1),W(J,2),Ax,Ay)
5334 CALL Csub(Wr(1,6),Wr(1,7),Ax,Ay,Ax,Ay)
5337 CALL Csub(W(J,5),W(J,6),Wr(2,8),Wr(2,9),Bx,By)
5340 CALL Csub(W(J,1),W(J,2),Wr(1,8),Wr(1,9),Cx,Cy)
5343 CALL Cmpy(Wr(2,10),Wr(2,11),W(J,5),W(J,6),Dx,Dy)
5346 CALL Csub(Wr(2,6),Wr(2,7),Dx,Dy,Dx,Dy)
5349 A(2*I-1)=(Ax*Ax+Ay*Ay)/(Bx*Bx+By*By)*W(J,3)/W(J,7)
5352 A(2*I)=(Cx*Cx+Cy*Cy)/(Dx*Dx+Dy*Dy)*W(J,3)/W(J,7)
5355 NEXT I
5358 R=SUM(A)/8
5361 MAT A=A-(R)
5364 Res=SQR(DOT(A,A)/7)/R  !  (Std dev)/(mean)
5367 SUBEND
! ************************************************************
S Pratio(
A                5364

A(               5322   5349   5352   5358   5361   5361   5364

Ax               5331   5334   5334   5349   5349

Ay               5331   5334   5334   5349   5349

Bx               5337   5349   5349

By               5337   5349   5349

Cx               5340   5352   5352
Cy               5340   5352   5352

Dx               5343   5346   5346   5352   5352

Dy               5343   5346   5346   5352   5352

I                5325   5328   5349   5352   5355

J                5328   5331   5331   5337   5337   5340   5340
                 5343   5343   5349   5349   5352   5352

R                5319   5358   5361   5364

Res              5364

Row              5319   5328

W(               5319   5331   5331   5337   5337   5340   5340
                 5343   5343   5349   5349   5352   5352

Wr(              5319   5331   5331   5334   5334   5337   5337
                 5340   5340   5343   5343   5346   5346
```

```
5373 SUB Stds2(W(*),Wr(*),S(*),Res(*)) !-(81/12/18)-GFE-------
5376 ! Modification of "Stds" for use with Type N
       connector & "Tr13"
5379 DIM G(1:4,1:4),T(1:6)
5382 CALL Wg(Wr(*),1,1,W(3,1),W(3,2),S(4,1),S(4,2))
5385 CALL Wg(Wr(*),2,1,W(3,5),W(3,6),S(5,1),S(5,2))
5388 CALL Wg(Wr(*),1,1,W(4,1),W(4,2),S(6,1),S(6,2))
5391 CALL Wg(Wr(*),2,1,W(4,5),W(4,6),S(7,1),S(7,2))
5394 FOR I=1 TO 4
5397 FOR Sp=1 TO 2
5400 J=-(Sp=1)+3*(Sp=2)
5403 K=J+2*(Sp=2)
5406 CALL Wg(Wr(*),Sp,0,W(I+12,K),W(I+12,K+1),G(I,J),G(I,J+1))
5409 NEXT Sp
5412 NEXT I
5415 CALL Rtpt(G(*),1,T(*),Res(1,11))
5418 CALL Polar(T(2),T(5),S(8,1),S(8,2))
5421 CALL Cmpy(T(2),T(5),T(3),T(6),X,Y)
5424 CALL Csub(T(1),T(4),X,Y,X,Y)
5427 CALL Polar(X,Y,R,T)
5430 S(9,1)=SQR(R)
5433 S(9,2)=T/2-180*(T>0)  !  Default value between -180 & 0
5436 CALL Polar(-T(3),-T(6),S(10,1),S(10,2))
5439 SUBEND
5442 ! ******************************************
S Stds2(
G(              5379   5406   5406   5415

I               5394   5406   5406   5406   5406   5412

J               5400   5403   5406   5406

K               5403   5406   5406

R               5427   5430

Res(            5373   5415

S(              5373   5382   5382   5385   5385   5388   5388
                5391   5391   5418   5418   5430   5433   5436
                5436

Sp              5397   5400   5400   5403   5406   5409

T               5427   5433   5433

T(              5379   5415   5418   5418   5421   5421   5421
                5421   5424   5424   5436   5436

Wr(             5373   5382   5385   5388   5391   5406

X               5421   5424   5424   5427

Y               5421   5424   5424   5427
```

```
5445 SUB Tr15(W(*),Wr(*),Opt$,Stds(*),Res(*)) !-(82/04/14)-GFE--
5448 ! Modification of "Trl" routine.  Gives three options
5451 ! Opt$=1          Standard TRL routine
5454 ! Opt$=2L,(2R)   For Type N connector, assumes equal mag
                      gamma for "opens"
5457 !                & assigns phase of 180 to termination or
                      "short" on either Six-port#1 (left), or if
                      Opt$=2R to Six-port#2 (right)
5463 ! Option=3       Assumes equal mag gamma on "opens", equal
                      phase on "shorts"
5466 !                Obtains Mag Gamma from opens, phase from
                      shorts
5469 IF (Opt$="1") OR (Opt$="2L") OR (Opt$="2R") OR (Opt$="3")
     THEN 5478
5472 PRINT "IMPROPER FORMAT FOR Option$"
5475 GOTO 5703
5478 DIM S(1:6)
5481 DEG
5484 CALL Rtpt(W(*),5,S(*),Res(1,9))
5487 CALL Ident(Tax,S(1),Tbx,S(2),Tcx,S(3),Tay,S(4),Tby,S(5),
                Tcy,S(6)) ! "Thru"5490 CALL Rtpt(W(*),9,S(*),
                Res(1,10))
5493 CALL Ident(Lax,S(1),Lbx,S(2),Lcx,S(3),Lay,S(4),Lby,S(5),
                Lcy,S(6)) ! "Line"
5496 CALL Cmpy(Lbx,Lby,Tcx,Tcy,Ax,Ay)
5499 CALL Csub(Lax,Lay,Ax,Ay,Max,May)
5502 CALL Cmpy(Tax,Tay,Lbx,Lby,Ax,Ay)
5505 CALL Cmpy(Lax,Lay,Tbx,Tby,Bx,By)
5508 CALL Csub(Ax,Ay,Bx,By,Mbx,Mby)
5511 CALL Csub(Lcx,Lcy,Tcx,Tcy,Mcx,Mcy)
5514 CALL Cmpy(Tbx,Tby,Lcx,Lcy,Ax,Ay)
5517 CALL Csub(Tax,Tay,Ax,Ay,Mdx,Mdy)
5520 CALL Csub(Mdx/2,Mdy/2,Max/2,May/2,Bx,By)
5523 CALL Cdiv(Mcx,Mcy,Bx,By,Ax,Ay)
5526 CALL Cdiv(-Mbx,-Mby,Bx,By,Cx,Cy)
5529 CALL Cmpy(Ax,Ay,Cx,Cy,Dx,Dy)
5532 CALL Csub(1,0,Dx,Dy,Dx,Dy)
5535 R=SQR(SQR(Dx*Dx+Dy*Dy))
5538 T=(ATN(Dy/(Dx+1E-20))+180*(Dx<0)*SGN(Dy+1E-20))/2  ! Root
     choice made here
5541 CALL Cadd(1,0,R*COS(T),R*SIN(T),Dx,Dy)
5544 CALL Cdiv(-Cx,-Cy,Dx,Dy,Abx,Aby)
5547 CALL Cdiv(-Ax,-Ay,Dx,Dy,Acx,Acy)
5550 CALL Cmpy(Mbx,Mby,Acx,Acy,Ax,Ay)    ! Compute Exp(-gammal)
                                           for line
5553 CALL Cadd(Ax,Ay,Max,May,Ax,Ay)
5556 CALL Cmpy(Mcx,Mcy,Abx,Aby,Bx,By)
5559 CALL Cadd(Bx,By,Mdx,Mdy,Bx,By)
5562 CALL Cdiv(Ax,Ay,Bx,By,X,Y)
5565 CALL Polar(X,Y,R,T)
5568 Stds(3,1)=SQR(R)
5571 Stds(3,2)=T/2-180*(T>0)   ! Default value of line length
                               between -180 & 0
5574 CALL Cmpy(Acx,Acy,Tbx,Tby,Dx,Dy)
5577 CALL Csub(1,0,Dx,Dy,Dx,Dy)
```

```
5580 CALL Cmpy(Acx,Acy,Tax,Tay,Ax,Ay)   ! Compute elements
                                          of Mat B
5583 CALL Csub(Tcx,Tcy,Ax,Ay,Ax,Ay)
5586 CALL Cdiv(Ax,Ay,Dx,Dy,Bcx,Bcy)
5589 CALL Cmpy(Abx,Aby,Tcx,Tcy,Ax,Ay)
5592 CALL Csub(Tax,Tay,Ax,Ay,Ax,Ay)
5595 CALL Cdiv(Ax,Ay,Dx,Dy,Px,Py)
5598 CALL Csub(Tbx,Tby,Abx,Aby,Bx,By)
5601 CALL Cdiv(Bx,By,Ax,Ay,Bbx,Bby)
5604 FOR K=3 TO 4
5607 IF (Opt$="2R") AND (K=3) THEN 5628
5610 CALL Cmpy(Acx,Acy,W(K,1),W(K,2),Ax,Ay)
5613 CALL Csub(1,0,Ax,Ay,Ax,Ay)
5616 CALL Csub(W(K,1),W(K,2),Abx,Aby,Bx,By)
5619 CALL Cdiv(Bx,By,Ax,Ay,Ax,Ay)
5622 IF K=3 THEN CALL Polar(-Ax,-Ay,R,T)
5625 IF (Opt$="2L") AND (K=3) THEN 5679
5628 CALL Cadd(W(K,5),W(K,6),Bcx,Bcy,Bx,By)
5631 CALL Cmpy(W(K,5),W(K,6),Bbx,Bby,Cx,Cy)
5634 CALL Cadd(1,0,Cx,Cy,Cx,Cy)
5637 CALL Cdiv(Cx,Cy,Bx,By,Bx,By)
5640  IF (Opt$<>"2R") OR (K=4) THEN 5652
5643  CALL Cmpy(Px,Py,Bx,By,Cx,Cy)
5646  CALL Polar(-Cx,-Cy,R,T)
5649  GOTO 5679
5652 CALL Cmpy(Ax,Ay,Bx,By,Qx,Qy)
5655 CALL Cmpy(Px,Py,Qx,Qy,Ax,Ay)
5658 IF K=4 THEN 5682
5661 H=T
5664 T=(ATN(Ay/(Ax+1E-20))+180*(Ax<0)*SGN(Ay+1E-20))/2
5667 Q=T-H  ! This assumes calibration with nominal short
5670 IF ABS(Q)>180 THEN Q=Q-360*SGN(Q)
5673 IF ABS(Q)>90 THEN T=T+180
5676 IF Opt$="1" THEN 5682
5679 NEXT K
5682 R=SQR(SQR(Ax*Ax+Ay*Ay))
5685 CALL Rect(R,T,Aax,Aay)
5688 CALL Cdiv(Px,Py,Aax,Aay,Bax,Bay)
5691 CALL Cmpy(Acx,Acy,Aax,Aay,Acx,Acy)
5694 CALL Cmpy(Bbx,Bby,Bax,Bay,Bbx,Bby)
5697 CALL Ident(Wr(1,6),Aax,Wr(1,7),Aay,Wr(1,8),Abx,Wr(1,9),Aby,
              Wr(1,10),Acx,Wr(1,11),Acy)
5700 CALL Ident(Wr(2,6),Bax,Wr(2,7),Bay,Wr(2,8),-Bcx,Wr(2,9),-Bcy,
              Wr(2,10),-Bbx,Wr(2,11),-Bby)
5703 SUBEND
5706 ! ****************************************
```

```
S Tr15(


Aax              5685   5688   5691   5697

Aay              5685   5688   5691   5697

Abx              5544   5556   5589   5598   5616   5697
```

Aby	5544	5556	5589	5598	5616	5697	
Acx	5547	5550	5574	5580	5610	5691	5691
	5697						
acy	5547	5550	5574	5580	5610	5691	5691
	5697						
Ax	5496	5499	5502	5508	5514	5517	5523
	5529	5547	5550	5553	5553	5562	5580
	5583	5583	5586	5589	5592	5592	5595
	5601	5610	5613	5613	5619	5619	5622
	5652	5655	5664	5664	5682	5682	
Ay	5496	5499	5502	5508	5514	5517	5523
	5529	5547	5550	5553	5553	5562	5580
	5583	5583	5586	5589	5592	5592	5595
	5601	5610	5613	5613	5619	5619	5622
	5652	5655	5664	5664	5682	5682	
Bax	5688	5694	5700				
Bay	5688	5694	5700				
Bbx	5601	5631	5694	5694	5700		
Bby	5601	5631	5694	5694	5700		
Bcx	5586	5628	5700				
Bcy	5586	5628	5700				
Bx	5505	5508	5520	5523	5526	5556	5559
	5559	5562	5598	5601	5616	5619	5628
	5637	5637	5643	5652	5505	5508	5520
	5523	5526	5556	5559	5559	5562	5598
	5601	5616	5619	5628	5637	5637	5643
	5652						
Cx	5526	5529	5544	5631	5634	5634	5637
	5643	5646					
Cy	5526	5529	5544	5631	5634	5634	5637
	5643	5646					
Dx	5529	5532	5532	5535	5535	5538	5538
	5541	5544	5547	5574	5577	5577	5586
	5595						
Dy	5529	5532	5532	5535	5535	5538	5538
	5541	5544	5547	5574	5577	5577	5586
	5595						
H	5661	5667					

K 5604 5607 5610 5610 5616 5616 5622
5625 5628 5628 5631 5631 5640 5658
5679

Lax 5493 5499 5505

Lay 5493 5499 5505

Lbx 5493 5496 5502

Lby 5493 5496 5502

Lcx 5493 5511 5514

Lcy 5493 5511 5514

Max 5499 5520 5553

May 5499 5520 5553

Mbx 5508 5526 5550

Mby 5508 5526 5550

Mcx 5511 5523 5556

Mcy 5511 5523 5556

Mdx 5517 5520 5559

Mdy 5517 5520 5559

Opt$ 5445 5469 5469 5469 5469 5607 5625
5640 5676

Px 5595 5643 5655 5688

Py 5595 5643 5655 5688

Q 5667 5670 5670 5670 5670 5673

Qx 5652 5655

Qy 5652 5655

R 5535 5541 5541 5565 5568 5622 5646
5682 5685

Res(5445 5484 5490

S(5478 5484 5487 5487 5487 5487 5487
5487 5490 5493 5493 5493 5493 5493
5493

Stds(	5445	5568	5571				
T	5538	5541	5541	5565	5571	5571	5622
	5646	5661	5664	5667	5673	5673	5685
Tax	5487	5502	5517	5580	5592		
Tay	5487	5502	5517	5580	5592		
Tbx	5487	5505	5514	5574	5598		
Tby	5487	5505	5514	5574	5598		
Tcx	5487	5496	5511	5583	5589		
Tcy	5487	5496	5511	5583	5589		
W(	5445	5484	5490	5610	5610	5616	5616
	5628	5628	5631	5631			
Wr(	5445	5697	5697	5697	5697	5697	5697
	5700	5700	5700	5700	5700	5700	
X	5562	5565					
Y	5562	5565					

```
5709 SUB W(P(*),Row,N1,N2,Stp,Wr(*),W(*))    !---81/07/16--GFE-
5712 FOR Sp=1+(N1=0) TO 1+(N2>0)
5715 CALL Ident(R1,Wr(Sp,1),R2,Wr(Sp,2),W1,Wr(Sp,3),W2,Wr(Sp,4),
             W3,Wr(Sp,5),L,L)
5718 FOR I=1 TO N1*(Sp=1)+N2*(Sp=2)      ! Iterate over either
                                           N1 or N2
5721  Rw=Row+(I-1)*Stp
5724  L=4*(Sp-1)*(COL(P)=8)! Add 4 to column index as required
5727  P4=P(Rw,L+1)               ! Read in Pwr values
5730  IF P4=0 THEN Nexti ! If P4=0 no data here, skip to next row
5733  P3=P(Rw,L+2)
5736  P1=R1*P(Rw,L+3)
5739  P2=R2*P(Rw,L+4)
5742  S=(P3+P4+P1/R1+P2/R2)/10     ! Calc weighting factors
5745  S3=(P3+S)^2
5748  S4=(P4+S)^2
5751  S1=(P1+S*R1)^2
5754  S2=(P2+S*R2)^2
5757  P=P1*P1/S1+P2*P2/S2+P3*P3/S3+P4*P4/S4
5760  Q=P1/S1+P2/S2+P3/S3
5763  Wx=(W1+(P3-P1)/P4/W1)/2         ! Initial values
5766  Wy=((W2*W2+W3*W3+(P3-P2)/P4)/2-Wx*W2)/W3 !
5769  GOSUB F                ! Calc initial value of "F"
5772  R=1
5775  FOR K=1 TO 30           ! Begin Iteration
5778 Fa: Fa=Fb
5781   L=1
5784   Fs=E1/S1+E2/S2+E3/S3 ! Begin computation of derivatives
5787   Fx=Wx*Fs-W1*E1/S1-W2*E2/S2         ! =Fx/4
5790   Fy=Wy*Fs-W3*E2/S2                  ! =Fy/4
5793   D=Wx*Q-W1*P1/S1-W2*P2/S2
5796   E=Wy*Q-W3*P2/S2
5799   Ci=Fs+2*(Wx*Wx/S3+(Wx-W1)^2/S1+(Wx-W2)^2/S2-D*D/P)
                                          ! =Fxx/4
5802   Di=2*(Wx*Wy/S3+(Wx-W1)*Wy/S1+(Wx-W2)*(Wy-W3)/S2-D*E/P) !
                                          !  =Fxy/4
5805   Ei=Fs+2*(Wy*(Wy/S3+Wy/S1)+(Wy-W3)^2/S2-E*E/P)
                                          ! =Fyy/4
5808   Zi=Ci*Ei-Di*Di
5811   IF (Zi<0) OR (Ei<0) THEN Bkup
5814   X=(Fx*Ei-Fy*Di)/Zi        ! X,Y= correction as per Newton
                                   method
5817   Y=(Fy*Ci-Fx*Di)/Zi
5820   CALL Csub(Wx,Wy,X,Y,Wx,Wy)
5823   GOSUB F
5826   IF Fb<Fa+1E-10 THEN ON 1+(L=1)*(X*X+Y*Y<1E-12)
          GOTO Nextk,Exit
5829   L=2*L             ! Routine to reduce step size
5832   IF L=128 THEN Bkup2       ! Go to "backup routine"
5835   CALL Cadd(Wx,Wy,X/L,Y/L,Wx,Wy)! Restore a fraction of step
5838   GOTO 5823
5841 Nextk: NEXT K
5844 Error: PRINT "Abnormal exit from circle routine   ";"Sp= ";
                 Sp,"Row= ";Rw
5847        PRINT "Circle residual= ";Pi*SQR(Fb)/2
```

```
5850 Exit: L=4*(Sp=2)*(COL(W)=8)
5853       W(I,1+L)=Wx
5856       W(I,2+L)=Wy
5859       W(I,3+L)=Pi
5862       W(I,4+L)=Pi*SQR(Fb)/2
5865 Nexti: NEXT I
5868 NEXT Sp
5871 SUBEXIT
5874 ! ------------------------------------------------------
5877 Bkup2: CALL Cadd(Wx,Wy,X/64,Y/64,Wx,Wy)
5880 ! Backup algorithm based on Goldfeld, etal, Econometrica,
       July 1966, pg 541
5883 Bkup: Eg=(Ci+Ei-SQR((Ci-Ei)^2+4*Di*Di))/2     ! (Smallest
                                                     eigenvalue)/4
5886   IF Fx*Fx+Fy*Fy>1E-12 THEN Ka
5889   Ri=.1*SQR(P3*(P3<P1)*(P3<P2)+P1*(P1<P3)*(P1<P2)+P2*(P2<P1)
           *(P2<P3))
5892   X=-Ri*Di/SQR(Di*Di+(Ci-Eg)^2)
5895   Y=Ri*(Ci-Eg)/SQR(Di*Di+(Ci-Eg)^2)
5898   CALL Csub(Wx,Wy,X,Y,Wx,Wy)
5901   GOSUB F
5904   GOTO Fa
5907 Ka: FOR Ka=1 TO 20
5910    A1=Eg-R*SQR(Fx*Fx+Fy*Fy)      ! Correction to Fxx & Fyy
5913    CALL Csub(Ci,Ei,A1,A1,Ca,Ea)
5916    Za=Ca*Ea-Di*Di
5919    X=(Fx*Ea-Fy*Di)/Za
5922    Y=(Fy*Ca-Fx*Di)/Za
5925    CALL Csub(Wx,Wy,X,Y,Wx,Wy)
5928    GOSUB F
5931    Zc=(Fb-Fa)/(2*(Ci*X*X+2*Di*X*Y+Ei*Y*Y)-4*(Fx*X+Fy*Y))-1
5934    IF Fb>Fa+1E-10 THEN Zc=-2 ! This insures a reduced step size
5937    R=R*(.4+3.6*(ABS(Zc)>.3)*(1-(ABS(Zc)<1)*(1-ABS(Zc))/.7))
5940    IF Zc>-1 THEN 5841
5943    CALL Cadd(Wx,Wy,X,Y,Wx,Wy)! Returns to original position and
5946   NEXT Ka                      ! repeats with smaller step size
5949   GOTO Error
5952 F: Wm=Wx*Wx+Wy*Wy           ! Compute value of "F"  (=Fb)
5955 W1m=Wm+W1*(W1-2*Wx)
5958 W2m=Wm+W2*(W2-2*Wx)+W3*(W3-2*Wy)
5961 Pi=P/(Wm*P3/S3+P4/S4+W1m*P1/S1+W2m*P2/S2)
5964 E3=Wm-P3/Pi
5967 E1=W1m-P1/Pi
5970 E2=W2m-P2/Pi
5973 Fb=E1*E1/S1+E2*E2/S2+E3*E3/S3+(1-P4/Pi)^2/S4
5976 RETURN
5979 SUBEND
5982 ! ****************************************
```

```
S W(


A1                5910   5913   5913

Bkup2:            5877   5832
```

Bkup: 5883 5811

Ca 5913 5916 5922

Ci 5799 5808 5817 5883 5883 5892 5895
5895 5913 5931

D 5793 5799 5799 5802

Di 5802 5808 5808 5814 5817 5883 5883
5892 5892 5892 5895 5895 5916 5916
5919 5922 5931 5796 5802 5805 5805

El 5784 5787 5967 5973 5973

E2 5784 5787 5790 5970 5973 5973

E3 5784 5964 5973 5973

Ea 5913 5916 5919

Eg 5883 5892 5895 5895 5910

Ei 5805 5808 5811 5814 5883 5883 5913
5931

Error: 5844 5949

Exit: 5850 5826

F: 5952 5769 5823 5901 5928

Fa 5778 5826 5931 5934

Fa: 5778 5904

Fb 5778 5826 5847 5862 5931 5934 5973

Fs 5784 5787 5790 5799 5805

Fx 5787 5814 5817 5886 5886 5910 5910
5919 5922 5931

Fy 5790 5814 5817 5886 5886 5910 5910
5919 5922 5931

I 5718 5721 5853 5856 5859 5862 5865

K 5775 5841

Ka 5907 5946

Ka: 5907 5886

L 5715 5715 5724 5727 5733 5736 5739
5781 5826 5829 5829 5832 5835 5835
5850 5853 5856 5859 5862

N1 5709 5712 5718

N2 5709 5712 5718

Nexti: 5865 5730

Nextk: 5841 5826

P 5757 5799 5802 5805 5961

P(5709 5724 5727 5733 5736 5739

P1 5736 5742 5751 5757 5757 5760 5763
5793 5889 5889 5889 5889 5889 5961
5967

P2 5739 5742 5754 5757 5757 5760 5766
5793 5796 5889 5889 5889 5889 5889
5961 5970

P3 5733 5742 5745 5757 5757 5760 5763
5766 5889 5889 5889 5889 5889 5961
5964

P4 5727 5730 5742 5748 5757 5757 5763
5766 5961 5973

Pi 5847 5859 5862 5961 5964 5967 5970
5973

Q 5760 5793 5796

R 5772 5910 5937 5937

R1 5715 5736 5742 5751

R2 5715 5739 5742 5754

Ri 5889 5892 5895

Row 5709 5721

Rw 5721 5727 5733 5736 5739 5844

S 5742 5745 5748 5751 5754

S1 5751 5757 5760 5784 5787 5793 5799
5802 5805 5961 5973

S2 5754 5757 5760 5784 5787 5790 5793
5796 5799 5802 5805 5961 5973

S3	5745	5757	5760	5784	5799	5802	5805
	5961	5973					
S4	5748	5757	5961	5973			
Sp	5712	5715	5715	5715	5715	5715	5718
	5718	5724	5844	5850	5868		
Stp	5709	5721					
W(	5709	5850	5853	5856	5859	5862	
W1	5715	5763	5763	5787	5793	5799	5802
	5955	5955					
W1m	5955	5961	5967				
W2	5715	5766	5766	5766	5787	5793	5799
	5802	5958	5958				
W2m	5958	5961	5970				
W3	5715	5766	5766	5766	5790	5796	5802
	5805	5958	5958				
Wm	5952	5955	5958	5961	5964		
Wr(	5709	5715	5715	5715	5715	5715	
Wx	5763	5766	5787	5793	5799	5799	5799
	5799	5802	5802	5802	5820	5820	5835
	5835	5853	5877	5877	5898	5898	5925
	5925	5943	5943	5952	5952	5955	5958
Wy	5766	5790	5796	5802	5802	5802	5805
	5805	5805	5805	5820	5820	5835	5835
	5856	5877	5877	5898	5898	5925	5925
	5943	5943	5952	5952	5958		
X	5814	5820	5826	5826	5835	5877	5892
	5898	5919	5925	5931	5931	5931	5931
	5943						
Y	5817	5820	5826	5826	5835	5877	5895
	5898	5922	5925	5931	5931	5931	5931
	5943						
Za	5916	5919	5922				
Zc	5931	5934	5937	5937	5937	5940	
Zi	5808	5811	5814	5817			

```
5985 SUB Rtpt(G(*),Row,S(*),R) !-(81/05/11)-GFE---
5988 ! Compute two-port cascading parameters (Ax,Bx,Cx,& Ay,By,Cy
       )=S(1)---S(6)
5991 DIM B(1:8,1:6),X(1:8),Y(1:8)
5994 L=2*(COL(G)>4) ! Adjustment for two different formats for "G"
5997 FOR I=1 TO 4
6000 J=I+4
6003 K=I+Row-1
6006 B(I,1)=B(J,4)=1
6009 B(I,2)=B(J,5)=C=G(K,3+L)
6012 B(I,3)=B(J,6)=A=-G(K,1)
6015 B(I,4)=B(J,1)=0
6018 B(I,5)=D=-G(K,4+L)
6021 B(I,6)=B=G(K,2)
6024 B(J,2)=-D
6027 B(J,3)=-B
6030 CALL Cmpy(-A,B,C,-D,Y(I),Y(J))
6033 NEXT I
6036 CALL Msoln(B(*),Y(*),S(*))
6039 MAT X=B*S
6042 MAT X=Y-X
6045 R=SQR(DOT(X,X)/DOT(S,S))
6048 SUBEND
6051 ! ********************************
```

S Rtpt(

A	6012	6030					
B	6021	6027	6030				
B(	5991	6006	6006	6009	6009	6012	6012
	6015	6015	6018	6021	6024	6027	6036
	6039						
C	6009	6030					
D	6018	6024	6030				
G(	5985	5994	6009	6012	6018	6021	
I	5997	6000	6003	6006	6009	6012	6015
	6018	6021	6030	6033			
J	6000	6006	6009	6012	6015	6024	6027
	6030						
K	6003	6009	6012	6018	6021		
L	5994	6009	6018				
R	5985	6045					
Row	5985	6003					

S	6045				
S(	5985	6036	6039	6045	
X	6045				
X(	5991	6039	6042	6042	6045
Y(	5991	6030	6030	6036	6042

```
6054 SUB Msoln(B(*),Y(*),X(*)) !-(80/1/16)-------GFE-----------
6057 OPTION BASE 1
6060 DIM A(9,9),C(9,16),U(9)
6063 M=ROW(B)
6066 N=COL(B)
6069 REDIM A(N,N),C(N,M),U(N)
6072 MAT C=TRN(B)
6075 MAT A=C*B
6078 MAT A=INV(A)
6081 MAT U=C*Y
6084 MAT X=A*U
6087 SUBEND
6090 ! **********************************
```

```
S Msoln(


A(              6060   6069   6075   6078   6078   6084

B(              6054   6063   6066   6072   6075

C(              6060   6069   6072   6075   6081

M               6063   6069

N               6066   6069   6069   6069   6069

U(              6060   6069   6081   6084

X(              6054   6084

Y(              6054   6081
```

```
6093 SUB Wg(Wr(*),I,F,Wx,Wy,X,Y)  !-(80/1/9)-GFE------------
6096 CALL Csub(Wx,Wy,Wr(I,8),Wr(I,9),Nx,Ny)
6099 CALL Cmpy(Wr(I,10),Wr(I,11),Wx,Wy,X,Y)
6102 CALL Csub(Wr(I,6),Wr(I,7),X,Y,Dx,Dy)
6105 CALL Cdiv(Nx,Ny,Dx,Dy,X,Y)
6108 IF F=1 THEN CALL Polar(X,Y,X,Y)
6111 SUBEND
6114 ! ********************************
```

```
S Wg(

Dx                6102   6105

Dy                6102   6105

F                 6093   6108

I                 6093   6096   6096   6099   6099   6102   6102

Nx                6096   6105

Ny                6096   6105

Wr(               6093   6096   6096   6099   6099   6102   6102

Wx                6093   6096   6099

Wy                6093   6096   6099

X                 6093   6099   6102   6105   6108   6108

Y                 6093   6099   6102   6105   6108   6108
```

```
6117 SUB Wq(W(*),Q(*)) !--80/04/03---GFE-----------------
6120 FOR I=1 TO ROW(W)
6123 CALL Ident(A,W(I,1),B,W(I,2),C,W(I,3),D,W(I,4),E,W(I,5),F,
               W(I,6))
6126 CALL Ident(G,W(I,7),H,W(I,8),P,W(I,9),Q,W(I,10),R,W(I,11),
               Q(I,12),W(I,12))
6129 CALL Polar(-Q,-R,Q(I,1),Q(I,2))
6132 Q(I,9)=S=SQR(F*F+G*G)
6135 CALL Polar((-F*H-G*P)/S/S,(G*H-F*P)/S/S,Q(I,3),Q(I,4))
6138 CALL Wg(W(*),I,1,C,0,Q(I,5),Q(I,6))
6141 CALL Wg(W(*),I,1,D,E,Q(I,7),Q(I,8))
6144 Q(I,10)=SQR(((F-C*Q)^2+(G-C*R)^2)/A)
6147 Q(I,11)=SQR(((F-D*Q+E*R)^2+(G-D*R-E*Q)^2)/B)
6150 NEXT I
6153 SUBEND
6156 ! ****************************

S Wq(

A               6123   6144

B               6123   6147

C               6123   6138   6144   6144

D               6123   6141   6147   6147

E               6123   6141   6147   6147

F               6123   6132   6132   6135   6135   6144   6147

G               6126   6132   6132   6135   6135   6144   6147

H               6126   6135   6135

I               6120   6123   6123   6123   6123   6123   6123
                6126   6126   6126   6126   6126   6126   6126
                6129   6129   6132   6135   6135   6138   6138
                6138   6141   6141   6141   6144   6147   6150

P               6126   6135   6135

Q               6126   6129   6144   6147   6147

Q(              6117   6126   6129   6129   6132   6135   6135
                6138   6138   6141   6141   6144   6147

R               6126   6129   6144   6147   6147

S               6132   6135   6135   6135   6135

W(              6117   6120   6123   6123   6123   6123   6123
                6123   6126   6126   6126   6126   6126   6126
                6138   6141
```

```
6159 SUB Mg(P(*),Row,Sp,Wr(*),F$,X,Y,Res)   !-(81/07/16)-GFE--
6162 DIM W(1:1,1:4)
6165 CALL W(P(*),Row,Sp=1,Sp=2,1,Wr(*),W(*))
6168 CALL Wg(Wr(*),Sp,P,W(1,1),W(1,2),X,Y)
6171 IF F$="P" THEN CALL Polar(X,Y,X,Y)
6174 Res=W(1,4)
6177 SUBEND
6180 ! ********************************
```

```
S Mg(


F$              6159   6171

P               6168

P(              6159   6165

Res             6159   6174

Row             6159   6165

Sp              6159   6165   6165   6168

W(              6162   6165   6168   6168   6174

Wr(             6159   6165   6168

X               6159   6168   6171   6171

Y               6159   6168   6171   6171
```

```
6183 SUB Cadd(Ax,Ay,Bx,By,Cx,Cy) !-(80/1/16)--GFE---
6186 Cx=Ax+Bx
6189 Cy=Ay+By
6192 SUBEND
6195 ! ************************************
```

```
S Cadd(


Ax                6183   6186

Ay                6183   6189

Bx                6183   6186

By                6183   6189

Cx                6183   6186

Cy                6183   6189
```

```
6198 SUB Csub(Ax,Ay,Bx,By,Cx,Cy) !-(80/1/16)---------GFE--
6201 Cx=Ax-Bx
6204 Cy=Ay-By
6207 SUBEND
6210 ! ********************************
```

```
S Csub(


Ax                6198   6201

Ay                6198   6204

Bx                6198   6201

By                6198   6204

Cx                6198   6201

Cy                6198   6204
```

```
6213 SUB Cmpy(Ax,Ay,Bx,By,Cx,Cy) !-(80/1/16)-GFE----
6216 CALL Ident(X,Ax,Y,Ay,U,Bx,V,By,A,0,B,0)
6219 Cx=X*U-Y*V
6222 Cy=X*V+Y*U
6225 SUBEND
6228 ! *********************************
```

```
S Cmpy(


A                 6216

Ax                6213   6216

Ay                6213   6216

B                 6216

Bx                6213   6216

By                6213   6216

Cx                6213   6219

Cy                6213   6222

U                 6216   6219   6222

V                 6216   6219   6222

X                 6216   6219   6222

Y                 6216   6219   6222
```

```
6231 SUB Cdiv(Ax,Ay,Bx,By,Cx,Cy) !-(80/1/16)--GFE--------------
6234 CALL Ident(X,Ax,Y,Ay,U,Bx,V,By,A,Bx*Bx+By*By,B,0)
6237 Cx=(X*U+Y*V)/A
6240 Cy=(Y*U-X*V)/A
6243 SUBEND
6246 ! **********************************
```

```
S Cdiv(


A                 6234   6237   6240

Ax                6231   6234

Ay                6231   6234

B                 6234

Bx                6231   6234   6234   6234

By                6231   6234   6234   6234

Cx                6231   6237

Cy                6231   6240

U                 6234   6237   6240

V                 6234   6237   6240

X                 6234   6237   6240

Y                 6234   6237   6240
```

```
6249 SUB Ident(A,B,C,D,E,F,G,H,I,J,K,L) !--(80/1/16)---GFE-----
6252 A=B
6255 C=D
6258 E=F
6261 G=H
6264 I=J
6267 K=L
6270 SUBEND
6273 ! ************************************
```

```
S Ident(


A                 6249   6252

B                 6249   6252

C                 6249   6255

D                 6249   6255

E                 6249   6258

F                 6249   6258

G                 6249   6261

H                 6249   6261

I                 6249   6264

J                 6249   6264

K                 6249   6267

L                 6249   6267
```

```
6276 SUB Polar(Xo,Y,R,T) !--(80/1/16)--GFE-----
6279 DEG
6282 X=Xo
6285 R=SQR(X*X+Y*Y)
6288 T=ATN(Y/(X+1E-20))+180*(X<0)*SGN(Y+1E-20)
                              ! Range -180 to +180
6291 SUBEND
6294 ! **********************
```

```
S Polar(


R                 6276   6285

T                 6276   6288

X                 6282   6285   6285   6288   6288

Xo                6276   6282

Y                 6276   6285   6285   6288   6288
```

```
6297 SUB Rect(Ro,T,X,Y) !--(80/1/16)----------GFE-----
6300 DEG
6303 R=Ro
6306 X=R*COS(T)
6309 Y=R*SIN(T)
6312 SUBEND
6315 ! ***************************

S Rect(


R                 6303   6306   6309

Ro                6297   6303

T                 6297   6306   6309

X                 6297   6306

Y                 6297   6309
```

```
6318 SUB Cpwr(Pstd,Pwr(*),Row,Sp,Wr(*),Res) !--(81/05/06)-GFE---
6321 CALL Mpwr(Pwr(*),Row,Sp,Wr(*),"N",X,Y,"Net",Pnet,Res)
6324 Wr(1,12)=Pstd/Pnet
6327 Wr(2,12)=Wr(2,12)*Wr(1,12)
6330 SUBEND
6333 ! ******************************
```

```
S Cpwr(


Pnet              6321   6324

Pstd              6318   6324

Pwr(              6318   6321

Res               6318   6321

Row               6318   6321

Sp                6318   6321

Wr(               6318   6321   6324   6327   6327   6327

X                 6321

Y                 6321
```

```
6336 SUB Mpwr(P(*),Row,Sp,Wr(*),G$,X,Y,P$,P,Res) !-81/07/16)--GFE
6339 DIM W(1:1,1:4)
6342 CALL W(P(*),Row,Sp-1,Sp-2,1,Wr(*),W(*))
6345 CALL Cmpy(Wr(Sp,10),Wr(Sp,11),W(1,1),W(1,2),Ax,Ay)
6348 CALL Csub(Wr(Sp,6),Wr(Sp,7),Ax,Ay,Ax,Ay)
6351 P=Pinc=W(1,3)*Wr(Sp,12)*(Ax*Ax+Ay*Ay)
6354 IF (G$="R")+(G$="P")+(P$="Net")=0 THEN Exit
6357 CALL Wg(Wr(*),Sp,0,W(1,1),W(1,2),X,Y)
6360 IF P$="Net" THEN P=P*(1-X*X-Y*Y)
6363 IF G$="P" THEN CALL Polar(X,Y,X,Y)
6366 Exit: Res=W(1,4)
6369 SUBEND

S Mpwr(


Ax              6345   6348   6348   6351   6351

Ay              6345   6348   6348   6351   6351

Exit:           6366   6354

G$              6336   6354   6354   6363

P               6336   6351   6360   6360

P$              6336   6354   6360

P(              6336   6342

Pinc            6351

Res             6336   6366

Row             6336   6342

Sp              6336   6342   6342   6345   6345   6348   6348
                6351   6357

W(              6339   6342   6345   6345   6351   6357   6357
                6366

Wr(             6336   6342   6345   6345   6348   6348   6351
                6357

X               6336   6357   6360   6360   6363   6363

Y               6336   6357   6360   6360   6363   6363
```

```
6372 SUB Mtpt(P(*),Row,Stp,Wr(*),F$,S(*),R(*)) !-(81/07/16)--GFE
6375 MAT R=ZER
6378 DIM W(1:4,1:8),C(1:6),G(1:4,1:4)
6381 CALL W(P(*),Row,4,4,Stp,Wr(*),W(*))
6384 FOR I=1 TO 4
6387 FOR Sp=1 TO 2
6390 J=(Sp=1)+5*(Sp=2)
6393 CALL Wg(Wr(*),Sp,0,W(I,J),W(I,J+1),G(I,2*Sp-1),G(I,2*Sp))
6396 R(Sp)=R(Sp)+W(I,4*Sp)
6399 NEXT Sp
6402 NEXT I
6405 MAT R=R/(4)
6408 CALL Rtpt(G(*),1,C(*),R(3))
6411 CALL Cmpy(C(2),C(5),C(3),C(6),Ax,Ay)
6414 CALL Csub(C(1),C(4),Ax,Ay,Ax,Ay)
6417 CALL Polar(Ax,Ay,R,T)
6420 T=T/2-180*(T>0)  ! -180<(Default value)<0
6423 IF F$="P" THEN P
6426 CALL Rect(SQR(R),T,X,Y)
6429 CALL Ident(S(1),C(2),S(2),C(5),S(5),-C(3),S(6),-C(6),S(3),X,
                S(4),Y)
6432 GOTO Exit
6435 P: CALL Polar(C(2),C(5),S(1),S(2))
6438    CALL Polar(-C(3),-C(6),S(5),S(6))
6441 S(3)=SQR(R)
6444 S(4)=T
6447  SUBEND
6450 Pset: ! PSET AT 3450
6460  RE-SAVE "ADP11",6460,11000  !850730
                                    CODED TO UTILIZE DUAL SIX-PORT
```

S Mtpt(

Ax	6411	6414	6414	6417			
Ay	6411	6414	6414	6417			
C(	6378	6408	6411	6411	6411	6411	6414
	6414	6429	6429	6429	6429	6435	6435
	6438	6438					
Exit:	0	6432					
F$	6372	6423					
G(	6378	6393	6393	6408			
I	6384	6393	6393	6393	6393	6396	6402
J	6390	6393	6393				
P(	6372	6381					
P:	6435	6423					

Pset:	6450						
R	6417	6426	6441				
R(	6372	6375	6396	6396	6405	6405	6408
Row	6372	6381					
S(	6372	6429	6429	6429	6429	6429	6429
	6435	6435	6438	6438	6441	6444	
Sp	6387	6390	6390	6393	6393	6393	6396
	6396	6396	6399				
Stp	6372	6381					
T	6417	6420	6420	6420	6426	6444	
W(	6378	6381	6393	393	6396		
Wr(	6372	6381	6393				
X	6426	6429					
Y	6426	6429					

```
6470  DEF FNAdp(Nfreqs,Repeats,M1,P1,M2,P2,Ca$)
6480  !   CALC      PARAMETERS   FOR ADAPTOR  FROM 6PORT MEAS
          JULY-AUG 1985
6490  OPTION BASE 1
6500  Msu$=":F8,1"
6510  DIM Result(Nfreqs,60),Freqs(Nfreqs),Id_content$[80],
          S(Nfreqs,34)
6521  K=0
6570 ! LINPUT "ENTER FILE NAME FOR DATA
       WITHOUT  ADAPTER",N1$
6580  FIXED 0
6590 ! LINPUT "ENTER FILE NAME FOR DATA WITH ADAPTER          ",N2$
6620  N1$="CRST1"
6630  N2$="CRST3"
6640   CALL Redhed(N1$,Msu$,Date$,Time$,Typ$,Nfreqs,Freqs(*),
                   Repeats,Sp,Std_mnt,Id_content$,Cnnct$)
6650  MASS STORAGE IS ":F8,1"
6660  PRINTER IS 16
6670  PRINT "START OF FNADPT"
6680  Nfreq=N=Nfreqs
6690  PRINT
6700  PRINT
6710   Sport=1
6720  PRINTER IS 0
6721  PRINT
6724  PRINT "ADAPTER EVALUATION"
6725  PRINT "------------------"
6727  PRINT
6730  PRINT "FILES PROCESSED =";N1$;" AND ";N2$
6740  PRINT
6750  N1=INT(N1)
6760  N2=INT(N2)
6770  PRINTER IS 16
6780  FOR P=1 TO Nfreqs
6790  FOR Prt=1 TO 2
6800  PRINTER IS 16
6810  ON Prt GOTO 6820,6850
6820         CALL Redwrt(N1$,":F8,1"," ",Result(*),Nfreqs)
6830         Nfreq=1
6840  GOTO 6870
6850         CALL Redwrt(N2$,":F8,1"," ",Result(*),Nfreqs)
6860         NORMAL
6870  ON Sport GOTO 6880,6900
6880  Mc=0
6890  GOTO 6910
6900  Mc=12
6910  A8=Result(P,6+Mc)
6920  A9=Result(P,7+Mc)
6930  B8=Result(P,8+Mc)
6940  B9=Result(P,9+Mc)
6950  C8=Result(P,10+Mc)
6960  C9=Result(P,11+Mc)
6980  GOTO 6990
6990  A11(Prt)=A8
7000 A22(Prt)=A9
```

```
7010   B11(Prt)=B8
7020   B22(Prt)=B9
7030  C11(Prt)=C8
7040  C22(Prt)=C9
7050  ON Prt GOTO 7060,7140
7060  FIXED 4
7061  PRINTER IS 16
7070  PRINT "FREQUENCY= ";Freqs(P);" GHZ"
7080  PRINT
7090  PRINT "ADAPTOR LOSS AT 6PORT NUMBER ";Sport
7100  PRINT
7110  PRINT "SYSTEM CONSTANTS"
7120  PRINT
7130  GOTO 7180
7140  PRINT
7150  PRINTER IS 16
7160  PRINT "ADAPTER CONSTANTS"
7170  PRINT
7180  FIXED 4
7190    PRINT "A8,A9,B8,B9,C8,C9"
7200    PRINT A8,A9,B8,B9,C8,C9
7210    PRINT
7220    PRINT "A1,A2,B1,B2,C1,C2";A11(Prt),A22(Prt),B11(Prt),
              B22(Prt),C11(Prt),C22(Prt)
7230    PRINT
7240    NEXT Prt
7250    !
7260    ! S11=(b'-b)/(a-b'c)
7270    !
7280  ! ____________________________________________________

7290        Z1=B11(2)
7300        Z2=B22(2)
7310        Z3=B11(1)
7320        Z4=B22(1)
7330        CALL Csua(Z1,Z2,Z3,Z4,Z9,Z0)
7340        Nr=Z9
7350        Ni=Z0
7360        Z3=C11(1)
7370        Z4=C22(1)
7380        CALL Cmua(Z1,Z2,Z3,Z4,Z9,Z0)
7390        Z3=Z9
7400        Z4=Z0
7410        Z1=A11(1)
7420        Z2=A22(1)
7430        CALL Csua(Z1,Z2,Z3,Z4,Z9,Z0)
7440        Z1=Nr
7450        Z2=Ni
7460        Z3=Z9
7470        Z4=Z0
7480        CALL Cdia(Z1,Z2,Z3,Z4,Z9,Z0)
7490        S11r=Z9
7500        S11i=Z0
7510      X=Z9
7520      Y=Z0
```

```
7530      CALL Crpa(X,Y,R,T)
7540      PRINT
7550      S11m=R
7560      S11a=T
7570      !
7580  !   S22=(a'c-ac')/(a-b'c)
7590  !
7600  ! ------------------------------------------------------------
7610        Z1=A11(2)
7620        Z2=A22(2)
7630        Z3=C11(1)
7640        Z4=C22(1)
7650        CALL Cmua(Z1,Z2,Z3,Z4,Z9,Z0)
7660        Mr=Z9
7670        Mi=Z0
7680        Z1=A11(1)
7690        Z2=A22(1)
7700        Z3=C11(2)
7710        Z4=C22(2)
7720        CALL Cmua(Z1,Z2,Z3,Z4,Z9,Z0)
7730        Z1=Mr
7740        Z2=Mi
7750        Z3=Z9
7760        Z4=Z0
7770        CALL Csua(Z1,Z2,Z3,Z4,Z9,Z0)
7780        Mr=Z9
7790        Mi=Z0
7800        Z1=B11(2)
7810        Z2=B22(2)
7820        Z3=C11(1)
7830        Z4=C22(1)
7840        CALL Cmua(Z1,Z2,Z3,Z4,Z9,Z0)
7850        Z3=Z9
7860        Z4=Z0
7870        Z1=A11(1)
7880        Z2=A22(1)
7890        CALL Csua(Z1,Z2,Z3,Z4,Z9,Z0)
7900        Z3=Z9
7910        Z4=Z0
7920        Z1=Mr
7930        Z2=Mi
7940        CALL Cdia(Z1,Z2,Z3,Z4,Z9,Z0)
7950        S22r=Z9
7960        S22i=Z0
7970        X=Z9
7980        Y=Z0
7990        CALL Crpa(X,Y,R,T)
8000        S22m=R
8010        S22a=T
8020      !
8030      ! S12^2=(a'-bc')/(a-b'c)+S11*S22
8040      !
8050  ! ------------------------------------------------------------
8060      Z3=C11(2)
8070      Z4=C22(2)
```

```
8080      Z1=B11(1)
8090      Z2=B22(1)
8100      CALL Cmua(Z1,Z2,Z3,Z4,Z9,Z0)
8110      Z1=A11(2)
8120      Z2=A22(2)
8130      Z3=Z9
8140      Z4=Z0
8150      CALL Csua(Z1,Z2,Z3,Z4,Z9,Z0)
8160      Mr=Z9
8170      Mi=Z0
8180      Z1=B11(2)
8190      Z2=B22(2)
8200      Z3=C11(1)
8210      Z4=C22(1)
8220      CALL Cmua(Z1,Z2,Z3,Z4,Z9,Z0)
8230      Z1=A11(1)
8240      Z2=A22(1)
8250      Z3=Z9
8260      Z4=Z0
8270      CALL Csua(Z1,Z2,Z3,Z4,Z9,Z0)
8280      Z1=Mr
8290      Z2=Mi
8300      Z3=Z9
8310      Z4=Z0
8320      CALL Cdia(Z1,Z2,Z3,Z4,Z9,Z0)
8330      Mr=Z9
8340      Mi=Z0
8350      Z1=S11r
8360      Z2=S11i
8370      Z3=S22r
8380      Z4=S22i
8390      CALL Cmua(Z1,Z2,Z3,Z4,Z9,Z0)
8400      Z1=Z9
8410      Z2=Z0
8420      Z3=Mr
8430      Z4=Mi
8440      CALL Cada(Z1,Z2,Z3,Z4,Z9,Z0)
8450      Z1=Z9
8460      Z2=Z0
8470      CALL Csqra(Z1,Z2,Z9,Z0)
8480      S12r=Z9
8490      S12i=Z0
8500      S12m=SQR(Z9^2+Z0^2)
8510      S12a=ATN(S12i/S12r)*180/PI
8520      PRINT "S12m,S12a,S12r,S12i"
8530      PRINT S12m,S12a,S12r,S12i
8540      !
8550    ! ****************************************
8560    !  Alpha 210=|S21|^2/(1-|S22|^2)
8570    !  Alpha 120=|S21|^2/(1-|S11|^2)
8580    ! ----------------------------------------
8590      A120=S12m^2/(1-S11m^2)
8600      A210=S12m^2/(1-S22m^2)
8610      Db120=10*LGT(A120)
8620      Db210=10*LGT(A210)
```

```
8630     PRINTER IS 16
8640     PRINT
8650   ! PRINT "S12m, S12a, S12r, S12i"
8660     PRINTER IS 0
8670     FIXED 0
8680     PRINT
8690     PRINT "REFLECTION COEFFICIENTS FOR ADAPTER ON 6-PORT
               #";Sport
8691     FIXED 2
8700     PRINT
8701     PRINT "FREQUENCY:";Freqs(P);"GHZ"
8702     PRINT
8710     PRINT "S11 MAGNITUDE       S11 ANGLE           S11
               REAL            S11  IMAGINARY"
8720     PRINT "--------------      ---------           --------
               ----------"
8730     FIXED 4
8740     PRINT S11m,S11a,S11r,S11i
8750   PRINT
8760     PRINT "S22 MAGNITUDE       S22 ANGLE           S22 REAL
               S22  IMAGINARY"
8770     PRINT "--------------      ---------           --------
           ----------"
8780     PRINT S22m,S22a,S22r,S22i
8790     PRINT
8791     PRINT
8800     FIXED 0
8810     PRINT "LOSS DATA FOR ADAPTOR AN SIX-PORT";Sport
8820     PRINT "Alpha 12            LOSS DB              Alpha21
                       lOSS DB"
8830     PRINT "--------------      ---------            --------
               ------------"
8840    FIXED 4
8850   !  PRINT S12m,S12a,S12r,S12i
8860     PRINT A120,ABS(Db120),A210,ABS(Db210)
8870     K=0
8880     PRINT
8900     NORMAL
8920     IF Sport=2 THEN K=17
8921     IF Sport=1 THEN K=0
8930     S(P,K+1)=S11m
8940     S(P,K+2)=S11a
8950     S(P,K+3)=S11r
8960     S(P,K+4)=S11i
8970     S(P,K+5)=A120
8980     S(P,K+6)=S22m
8990     S(P,K+7)=S22a
9000     S(P,K+8)=S22r
9010     S(P,K+9)=S22i
9020     S(P,K+10)=A210
9030     S(P,K+11)=S12m
9040     S(P,K+12)=S21m
9050     ! ****************************************
9060     PRINTER IS 16
9070   ! THE FOLLOWING CODE EXISTS TO CALCULATE EFFICIENCY OF
```

```
        ADAPTER AND DUT
9080    !  ____________________________________________________
9090    !
9100  !  G1=S11+(S12*S21*Gx)/(1-S22*Gx)
9110    !
9111    ON Sport GOTO 9120,9132
9120    R=Gxm(Sport)=M1
9130    T=Gxa(Sport)=P1
9131    GOTO 9140
9132    R=Gxm(Sport)=M2
9133    T=Gxa(Sport)=P2
9140    CALL Cpra(R,T,X,Y)
9150    Gxr(Sport)=X
9160    Gxi(Sport)=Y
9210    Z1=Z3=S12r
9220    Z2=Z4=S12i
9230   CALL Cmua(Z1,Z2,Z3,Z4,Z9,Z0)
9240    Z1=Z9
9250    Z2=Z0
9260    Z3=Gxr1
9270    Z4=Gxi1
9280    CALL Cmua(Z1,Z2,Z3,Z4,Z9,Z0)
9290    Nur=Z9
9300    Nui=Z0
9310    PRINT Nur,Nui,Z9,Z0
9320    Z1=S22r
9330    Z2=S22i
9340    Z3=Gxm(Sport)
9350    Z4=0
9360    CALL Cmua(Z1,Z2,Z3,Z4,Z9,Z0)
9370   PRINT "S22GX"
9380   PRINT Z9,Z0
9390    Z1=1
9400    Z2=0
9410    Z3=Z9
9420    Z4=Z0
9430    CALL Csua(Z1,Z2,Z3,Z4,Z9,Z0)
9440  PRINT " 1-S22GX",Z9,Z0
9450    Z1=Nur
9460    Z2=Nui
9470    Z3=Z9
9480    Z4=Z0
9490    Mag1=SQR(Z9^2+Z0^2)^2
9500    CALL Cdia(Z1,Z2,Z3,Z4,Z9,Z0)
9510    Z1=S11r
9520    Z2=S11i
9530    PRINT "S11R, S11I",S11r,S11i
9540    PRINT S11r,S11i
9550    Z3=Z9
9560    Z4=Z0
9570    CALL Cada(Z1,Z2,Z3,Z4,Z9,Z0)
9580    G1r=Z9
9590    G1i=Z0
9600    !
9610  !  ____________________________________________________
```

```
9620  !
9630  ! Alpha12=[(1-|Gx|^2)*|S12|^2]/[(1-|G1|^2*|1-S22Gx|^2]
9631  ! 1-Gxm(1)^2*S12m^2/(1-G1m^2
9640  !
9660  Magn=(1-Gxm(Sport)^2)*S12m^2
9670  G1m=SQR(G1r^2+G1i^2)^2
9680  X=G1r
9690  Y=G1i
9700  CALL Crpa(X,Y,R,T)
9710  G1a=T
9720  Magd=(1-G1m)*Mag1
9730  Alpha12=Magn/Magd
9740  A12=Alpha12
9750  PRINTER IS 16
9760  PRINT "G1m,G1a, G1r,G1i"
9770  PRINT SQR(G1m),G1a,G1r,G1i
9780  PRINT "Gxm, Gxa, Gxr, Gxi"
9790  PRINT Gxm(Sport),Gxa(Sport),Gxr(Sport),Gxi(Sport)
9801  PRINTER IS 0
9805  PRINT "EFFICIENCY OF ADAPTER AND DEVICE COMBINATION:";A12
9806  PRINT
9807  PRINT
9808  PRINTER IS 16
9810  IF Sport=1 THEN GOTO 9830
9820  GOTO 9900
9830     S(P,K+13)=Gxm(Sport)
9840     S(P,K+14)=Gxa(Sport)
9850     S(P,K+15)=Gxi(Sport)
9860     S(P,K+16)=Gxr(Sport)
9861     S(P,K+17)=A12
9890    GOTO 9940
9900     S(P,K+13)=Gxm(Sport)
9910     S(P,K+14)=Gxa(Sport)
9920     S(P,K+15)=Gxi(Sport)
9930     S(P,K+16)=Gxr(Sport)
9931     S(P,K+17)=A12
9940  Sport=Sport+1
9950           IF Sport=2 THEN GOTO 6790
9951  PRINT PAGE
9952  Sport=1
9955  NEXT P
9960  GOTO 9980
9970     PRINTER IS 16
9980     MASS STORAGE IS ":F8,1"
9990     FOR I=1 TO 20
10000    NORMAL
10010 FIXED 0
10020    ASSIGN #1 TO "AD-"&VAL$(I),Check
10021   ASSIGN #1 TO *
10030    IF Check THEN Q$=VAL$(I)
10040    IF Check THEN 10060
10050    NEXT I
10060    CREATE "AD-"&Q$,2*Nfreqs
10070    ASSIGN #1 TO "AD-"&Q$
10080    PRINT #1;S(*)
```

```
10090   ASSIGN #1 TO *
10110    RETURN 0

FNAdp(

A11(            6990   7220   7410   7610   7680   7870   8110
                8230

A12             9740   9805   9861   9931

A120            8590   8610   8860   8970

A210            8600   8620   8860   9020

A22(            7000   7220   7420   7620   7690   7880   8120
                8240

A8              6910   6990   7200

A9              6920   7000   7200

Alpha12         9730   9740

B11(            7010   7220   7290   7310   7800   8080   8180

B22(            7020   7220   7300   7320   7810   8090   8190

B8              6930   7010   7200

B9              6940   7020   7200

C11(            7030   7220   7360   7630   7700   7820   8060
                8200

C22(            040    7220   7370   7640   7710   7830   8070
                8210

C8              6950   7030   7200

C9              6960   7040   7200

Ca$             6470

Check           10020  10030  10040

Cnnct$          6640

Date$           6640

Db120           8610   8860

Db210           8620   8860

Freqs(          6510   6640   7070   8701
```

Gla	9710	9770					
Gli	9590	9670	9690	9770			
Glm	9670	9720	9770				
Glr	9580	9670	9680	9770			
Gxa(	9130	9133	9790	9840	9910		
Gxi(	9160	9790	9850	9920			
Gxil	9270						
Gxm(	9120	9132	9340	9660	9790	9830	9900
Gxr(	9150	9790	9860	9930			
Gxrl	9260						
I	9990	10020	10030	10050			
Id_content$	6510	6640					
K	6521	8870	8920	8921	8930	8940	8950
	8960	8970	8980	8990	9000	9010	9020
	9030	9040	9830	9840	9850	9860	9861
	9900	9910	9920	9930	9931		
M1	6470	9120					
M2	6470	9132					
Magl	9490	9720					
Magd	9720	9730					
Magn	9660	9730					
Mc	6880	6900	6910	6920	6930	6940	6950
	6960						
Mi	7670	7740	7790	7930	8170	8290	8340
	8430						
Mr	7660	7730	7780	7920	8160	8280	8330
	8420						
Msu$	6500	6640					
N	6680						
N1	6750	6750					

N1$ 6620 6640 6730 6820

N2 6760 6760

N2$ 6630 6730 6850

Nfreq 6680 6830

Nfreqs 6470 6510 6510 6510 6640 6680 6780
6820 6850 10060

Ni 7350 7450

Nr 7340 7440

Nui 9300 9310 9460

Nur 9290 9310 9450

O 10110

P 6780 6910 6920 6930 6940 6950 6960
7070 8701 8930 8940 8950 8960 8970
8980 8990 9000 9010 9020 9030 9040
9830 9840 9850 9860 9861 9900 9910
9920 9930 9931 9955

P1 6470 9130

P2 6470 9133

Prt 6790 6810 6990 7000 7010 7020 7030
7040 7050 7220 7220 7220 7220 7220
7220 7240

Q$ 0 10030 10030 10060 10070

R 7530 7550 7990 8000 9120 9132 9140
9700

Repeats 6470 6640

Result(6510 6820 6850 6910 6920 6930 6940
6950 6960

S(6510 8930 8940 8950 8960 8970 8980
8990 9000 9010 9020 9030 9040 9830
9840 9850 9860 9861 9900 9910 9920
9930 9931 10080

S11a 7560 8740 8940

S11i 7500 8360 8740 8960 9520 9530 9540

S11m 7550 8590 8740 8930

S11r	7490	8350	8740	8950	9510	9530	9540
S12a	8510	8530					
S12i	8490	8510	8530	9220			
S12m	8500	8530	8590	8600	9030	9660	
S12r	8480	8510	8530	9210			
S21m	9040						
S22a	8010	8780	8990				
S22i	7960	8380	8780	9010	9330		
S22m	8000	8600	8780	8980			
S22r	7950	8370	8780	9000	9320		
Sp	6640						
Sport	6710	6870	7090	8690	8810	8920	8921
	9111	9120	9130	9132	9133	9150	9160
	9340	9660	9790	9790	9790	9790	9810
	9830	9840	9850	9860	9900	9910	9920
	9930	9940	9940	9950	9952		
Std_mnt	6640						
T	7530	7560	7990	8010	9130	9133	9140
	9700	9710					
Time$	6640						
Typ$	6640						
X	7510	7530	7970	7990	9140	9150	9680
	9700						
Y	7520	7530	7980	7990	9140	9160	9690
	9700						
Z0	7330	7350	7380	7400	7430	7470	7480
	7500	7520	7650	7670	7720	7760	7770
	7790	7840	7860	7890	7910	7940	7960
	7980	8100	8140	8150	8170	8220	8260
	8270	8310	8320	8340	8390	8410	8440
	8460	8470	8490	8500	9230	9250	9280
	9300	9310	9360	9380	9420	9430	9440
	9480	9490	9500	9560	9570	9590	
Z1	7290	7330	7380	7410	7430	7440	7480
	7610	7650	7680	7720	7730	7770	7800

	7840	7870	7890	7920	7940	8080	8100
	8110	8150	8180	8220	8230	8270	8280
	8320	8350	8390	8400	8440	8450	8470
	9210	9230	9240	9280	9320	9360	9390
	9430	9450	9500	9510	9570		
Z2	7300	7330	7380	7420	7430	7450	7480
	7620	7650	7690	7720	7740	7770	7810
	7840	7880	7890	7930	7940	8090	8100
	8120	8150	8190	8220	8240	8270	8290
	8320	8360	8390	8410	8440	8460	8470
	9220	9230	9250	9280	9330	9360	9400
	9430	9460	9500	9520	9570		
Z3	7310	7330	7360	7380	7390	7430	7460
	7480	7630	7650	7700	7720	7750	7770
	7820	7840	7850	7890	7900	7940	8060
	8100	8130	8150	8200	8220	8250	8270
	8300	8320	8370	8390	8420	8440	9210
	9230	9260	9280	9340	9360	9410	9430
	9470	9500	9550	9570			
Z4	7320	7330	7370	7380	7400	7430	7470
	7480	7640	7650	7710	7720	7760	7770
	7830	7840	7860	7890	7910	7940	8070
	8100	8140	8150	8210	8220	8260	8270
	8310	8320	8380	8390	8430	8440	9220
	9230	9270	9280	9350	9360	9420	9430
	9480	9500	9560	9570			
Z9	7330	7340	7380	7390	7430	7460	7480
	7490	7510	7650	7660	7720	7750	7770
	7780	7840	7850	7890	7900	7940	7950
	7970	8100	8130	8150	8160	8220	8250
	8270	8300	8320	8330	8390	8400	8440
	8450	8470	8480	8500	9230	9240	9280
	9290	9310	9360	9380	9410	9430	9440
	9470	9490	9500	9550	9570	9580	

```
10120 SUB Cmua(Z1,Z2,Z3,Z4,Z9,Z0)
10130 Z9=Z1*Z3-Z2*Z4
10140 Z0=Z1*Z4+Z2*Z3
10150 SUBEXIT
10160 SUBEND

S Cmua(


Z0              10120  10140

Z1              10120  10130  10140

Z2              10120  10130  10140

Z3              10120  10130  10140

Z4              10120  10130  10140

Z9              10120  10130
```

```
10170 SUB Cdia(Z1,Z2,Z3,Z4,Z9,Z0)
10180 Z6=Z3*Z3+Z4*Z4
10190 Z9=(Z1*Z3+Z2*Z4)/Z6
10200 Z0=(Z2*Z3-Z1*Z4)/Z6
10210 SUBEXIT
10220 SUBEND

S Cdia(


Z0              10170  10200

Z1              10170  10190  10200

Z2              10170  10190  10200

Z3              10170  10180  10180  10190  10200

Z4              10170  10180  10180  10190  10200

Z6              10180  10190  10200

Z9              10170  10190
```

```
10230 SUB Cinva(Z1,Z2,Z9,Z0)
10240 Z6=Z1*Z1+Z2*Z2
10250 Z9=Z1/Z6
10260 Z0=-Z2/Z6
10270 SUBEXIT
10280 SUBEND

S Cinva(


Z0              10230  10260

Z1              10230  10240  10240  10250

Z2              10230  10240  10240  10260

Z6              10240  10250  10260

Z9              10230  10250
```

```
10290 SUB Csqa(Z1,Z2,Z9,Z0)
10300 Z9=Z1*Z1-Z2*Z2
10310 Z0=2*Z1*Z2
10320 SUBEXIT
10330 SUBEND

S Csqa(


Z0              10290  10310

Z1              10290  10300  10300  10310

Z2              10290  10300  10300  10310

Z9              10290  10300
```

```
10340 SUB Cada(Z1,Z2,Z3,Z4,Z9,Z0)
10350 Z9=Z1+Z3
10360 Z0=Z2+Z4
10370 SUBEXIT
10380 SUBEND

S Cada(


Z0              10340  10360

Z1              10340  10350

Z2              10340  10360

Z3              10340  10350

Z4              10340  10360

Z9              10340  10350
```

```
10390 SUB Csua(Z1,Z2,Z3,Z4,Z9,Z0)
10400 Z9=Z1-Z3
10410 Z0=Z2-Z4
10420 SUBEXIT
10430 SUBEND

S Csua(


Z0              10390  10410

Z1              10390  10400

Z2              10390  10410

Z3              10390  10400

Z4              10390  10410

Z9              10390  10400
```

```
10440 SUB Caba(Z1,Z2,Z9)
10450 Z9=SQR(Z1*Z1+Z2*Z2)
10460 SUBEXIT
10470 SUBEND

S Caba(


Z1              10440  10450  10450

Z2              10440  10450  10450

Z9              10440  10450
```

```
10480 SUB Csqra(Z1,Z2,Z9,Z0)
10490 X=Z1
10500 Y=Z2
10510 CALL Crpa(X,Y,R,T)
10520 R=SQR(R)
10530 T=T/2
10540 Z9=R*COS(PI*T/180)
10550 Z0=R*SIN(PI*T/180)
10560 GOTO 10570
10570 SUBEXIT
10580 SUBEND

S Csqra(
```

R	10510	10520	10520	10540	10550
T	10510	10530	10530	10540	10550
X	10490	10510			
Y	10500	10510			
Z0	10480	10550			
Z1	10480	10490			
Z2	10480	10500			
Z9	10480	10540			

```
10590 SUB Crpa(X,Y,R,T)
10600 R=SQR(X*X+Y*Y)
10610 IF X=0 THEN GOTO 10640
10620 T=ATN(Y/X)
10630 GOTO 10650
10640 T=PI*SGN(Y)/2
10650 T=T*180/PI
10660 IF X>=0 THEN 10710
10670 IF Y>=0 THEN 10700
10680 T=T-180
10690 GOTO 10710
10700 T=T+180
10710 SUBEXIT
10720 SUBEND

S Crpa(

R               10590  10600

T               10590  10620  10640  10650  10650  10680  10680
                10700  10700

X               10590  10600  10600  10610  10620  10660

Y               10590  10600  10600  10620  10640  10670
```

```
10730 SUB Cmuada(Z1,Z2,Z3,Z4,Z5,Z6,Z7,Z8,Z9,Z0)
10740 Z9=Z1*Z3-Z2*Z4+Z5*Z7-Z6*Z8
10750 Z0=Z1*Z4+Z2*Z3+Z5*Z8+Z6*Z7
10760 SUBEXIT
10770 SUBEND

S Cmuada(


Z0              10730  10750

Z1              10730  10740  10750

Z2              10730  10740  10750

Z3              10730  10740  10750

Z4              10730  10740  10750

Z5              10730  10740  10750

Z6              10730  10740  10750

Z7              10730  10740  10750

Z8              10730  10740  10750

Z9              10730  10740
```

```
10780 SUB Cpra(R,T,X,Y)
10790 X=R*COS(PI*T/180)
10800 Y=R*SIN(PI*T/180)
10810 SUBEXIT
10820 SUBEND

S Cpra(


R               10780  10790  10800

T               10780  10790  10800

X               10780  10790

Y               10780  10800
```

```
10830 SUB Doc
10840 LINPUT "Today'S Date--AS 850729",Doda$
10850 PRINTER IS 0
10860 PRINT PAGE
10870 PRINT "CHANGES LISTED ARE AS OF ";Doda$
10880 PRINT "CHANGE 1. RENAMED TO TST1-FINAL NAME TO BE ADPTR5"
10890 PRINT "CHANGE 2. CHANGED DATE IN FNDtgs$ FROM 84 TO 85"
10900 PRINT "CHANGE 3. RENAMED SUB Pset TO SUB psetdeL (LINE 3456)"
10910 PRINT "CHANGE 4. CHANGED SUB Synth TO CALL SUB Synth_900
              (LINES 2830 TO"
10920 PRINT "           2931)."
10930 PRINT "CHANGE 5. INSERTED SUB Synth_900 AT LINE 8000 AND SUB"
10940 PRINT "           Pset AT 8140 AND SUB Genlevel AT 8480"
10950 PRINT "CHANGE 6. ADDED Cal=1 AT LINE 31"
10960 PRINT "CHANGE 7. ENTER INPUT STATEMENT FOR Nfreqs
              WHEN ADAPTR CALC ONLY IS
"
10970 PRINT "CHANGE 8. CHANGED Typ LOGIC TO INCLUDE TYP>5 AT
              LINE 75"
10980 PRINT "CHANGE 9. CHANGE Typ LOGIC AT LINE 76"
10990 PRINT "CHANGE 10. CHANGED OR ADDED LOGIC IN STATEMENTS
              78-79"
11000 PRINT "CHANGE 11. CHANGED OR ADDED Typ LOGIC IN LINES
              115-116"
11010 PRINT "CHANGE 12. CHANGED OR ADDED LOGIC LINES 119 AND
              121"
11020 PRINT "CHANGE 13. ADDED STATEMENT 164 AND 180"
11030 PRINT "CHANGE 14. CHANGED OR ADDED STATEMENTS AT LINES 224,
              225,226,235,"
11040 PRINT "           236,237,238, AND 239"
11050 PRINT "CHANGE 15. CHANGED FORMAT LINE 261"
11060 PRINT "CHANGE 16. ADDED LINE 275                          "
11070 PRINT "CHANGE 17. ADDED VARIABLE Proc TO CALLING STATEMENT
              IN LINES
11080 PRINT "           282,315,AND 333."
11090 PRINT "CHANGE 18.  ADDED OR CHANGED LOGIC IN LINES 367-371."
11100 PRINT "CHANGE 19. CHANGED FORMAT STATEMENT IN LINE 465/"
11110 PRINT "CHANGE 20. ADDED Cal TO SUB Caldat IN LINE 1077"
11120 PRINT "CHANGE 21. DEFINED Cal$ IN LINE 1093"
11130 PRINT "CHANGE 22. ADDED OR CHANGED LOGIC IN LINES 1265-1272."
11140 PRINT "CHANGE 23. ADDED(&)Ca$ TO STRING IN LINES 1299 AND 1302"
11150 PRINT "CHANGE 24. ADDED(&)Ca$ TO STRING IN LINES 1323 AND 1326"
11160 PRINT "CHANGE 25. ADDED Cal TO SUB Calres CALL AND SUB Caldat
              CALLS "
11170 PRINT "           IN LINES 168, 171,1077,AND 3612"
11180 PRINT "CHANGE 26. DIMENSIONED MATRIX Rd(Nfreqs,2,12) IN LINE
 "
11190 PRINT "           3624"
11200 PRINT "CHANGE 27. CHANGED VARIABLE LIST IN SUB Coeff--ADDED
              Cal AND Rd(*) "
11210 PRINT "           -DELETED Omitf(*) IN LINES 3727 AND 3795 "
11220 PRINT "CHANGE 28. ADDED  LINPUT STATEMENT AT LINE 3625."
11230 PRINT "CHANGE 29. ADDED &Ca$  TO FILE NAMES IN LINES 3639
              AND 3640"
11240 PRINT "CHANGE 30. ADDED LINES 3643 AND 3644."
```

```
11250 PRINT "CHANGE 31. ADDED DO LOOP FROM 3648 TO 3658."
11260 PRINT "CHANGE 32. ADDED LINES 3767 AND 3772."
11270 PRINT "CHANGE 33. ADDED ADAPTER CALC SUB PRORAM FNAdpt AT
            LINE 9000."
11280 SUBEXIT
11290 SUBEND

S Doc


Doda$            10840  10870
```

```
11300 SUB Gamma(Nfreqs,Repeats,Ca$)
11310   OPTION BASE 1
11320 DIM Power(Nfreqs,Repeats,16,10),Po(1,8),Result(Nfreqs,60),
              Wrspt(2,12)
11330 FREAD "1PRD"&"3"&":F8,1",Power(*)
11331 MASS STORAGE IS ": F8,1"
11332 PRINTER IS 0
11333   PRINT PAGE
11340 G=1
11350 PRINTER IS 16
11360 File$="CRST"&"2"
11370 FOR F=1 TO Nfreqs
11380 CALL Redwrt(File$,":F8,1"," ",Result(*),Nfreqs)
11390 FOR J=1 TO 2
11400 FOR N=1 TO 12
11410 PRINTER IS 0
11420 Wrspt(J,N)=Result(F,N+(J-1)*12)
11430 NEXT N
11440 NEXT J
11450 ! FOR I=1 TO 2
11460 ! Incr=(I=2)*5
11470 ! Inc=(I=2)*4
11480 FOR Mnt=1 TO 8
11490 Po(1,Mnt+Inc)=Power(F,1,1,Mnt+Incr)
11500 NEXT Mnt
11510 ! NEXT I
11520 CALL Mg(Po(*),1,1,Wrspt(*),"P",M1,P1,R1)
11530 CALL Mg(Po(*),1,2,Wrspt(*),"P",M2,P2,R2)
11540 PRINTER IS 0
11550 PRINT "FREQ #",F
11552 PRINT
11554 PRINT "DEVICE PLUS ADAPTER ON 6-PORT 1"
11555 PRINT
11560 PRINT "GAMMA MAGNITUDE","GAMMA PHASE"
11561 PRINT "---------------","-----------"
11562 PRINT USING 11585;M1,P1
11563 PRINT
11564 PRINT "DEVICE PLUS ADAPTER ON 6-PORT 2"
11565 PRINT
11567 PRINT "GAMMA MAGNITUDE","GAMMA PHASE"
11568 PRINT "---------------","-----------"
11570 PRINT USING 11585;M2,P2
11585 IMAGE MD.DDDDD,12X,MDDD.DDDD
11590 NEXT F
11591 NORMAL
11592 PRINT
11593 PRINT
11594 PRINT
11595 PRINTER IS 16
11600 Q=FNAdp(Nfreqs,Repeats,M1,P1,M2,P2,Ca$)
11610 SUBEXIT
11620 SUBEND

S Gamma(
```

Ca$	11300	11600				
F	11370	11420	11490	11550	11590	
File$	11360	11380				
G	11340					
Inc	11490					
Incr	11490					
J	11390	11420	11420	11440		
M1	11520	11562	11600			
M2	11530	11570	11600			
Mnt	11480	11490	11490	11500		
N	11400	11420	11420	11430		
Nfreqs	11300	11320	11320	11370	11380	11600
P1	11520	11562	11600			
P2	11530	11570	11600			
Po(	11320	11490	11520	11530		
Power(	11320	11330	11490			
Q	11600					
R1	11520					
R2	11530					
Repeats	11300	11320	11600			
Result(	11320	11380	11420			
Wrspt(	11320	11420	11520	11530		

GLOBAL NAMES

FNAdp(	6470	274	11600				
FNDerr(	4788	4563	4629	4677	4776		
FNDtg$	3129	1257					
FNNumd(	3216						
FNNumi(	3183	69	126	153	363	378	819
FNYorn	3153	178	219	456	696	795	852
	1290	2139	2916	3771	4797		
S Aline(	480	423					
S Avg(	3351	3969					
S Caba(	10440						
S Cada(	10340	8440	9570				
S Cadd(	6183	5541	5553	5559	5628	5634	5835
	5877	5943					
S Caldat(	1077	168	272				
S Calib(	4878	3837					
S Calres(	3612	171					
S Cdia(	10170	7480	7940	8320	9500		
S Cdiv(	6231	5523	5526	5544	5547	5562	5586
	5595	5601	5619	5637	5688	6105	
S Cinva(	10230						
S Cmpy(	6213	5331	5343	5421	5496	5502	5505
	5514	5529	5550	5556	5574	5580	5589
	5610	5631	5643	5652	5655	5691	5694
	6030	6099	6345	6411			
S Cmua(	10120	7380	7650	7720	7840	8100	8220
	8390	9230	9280	9360			
S Cmuada(	10730						
S Coeff(	3795	3727					
S Cpra(	10780	9140					

S Cpwr(6318

S Crpa(10590 7530 7990 9700 10510

S Csqa(10290

S Csqra(10480 8470

S Csua(10390 7330 7430 7770 7890 8150 8270
9430

S Csub(6198 4353 5334 5337 5340 5346 5424
5499 5508 5511 5517 5520 5532 5577
5583 5592 5598 5613 5616 5820 5898
5913 5925 6096 6102 6348 6414

S Dac(3096 3441

S Disc_copy(4404 224

S Disc_trans(4440

S Doc 10830

S Dvms(2421 2280 2535 2556

S F_limt(990 654 780

S F_step(633 435

S F_type(711 444

S Fase_shft(3057 1698 1766 1896

S Fdata(1575 1095

S Filter(2940 3435

S Fparab(5088 4905

S Freq(333 315

S Freqin(282 83

S Gamma(11300 80 239 273

S Ident(6249 5487 5493 5697 5700 5715 6123
6126 6216 6234 6429

RRS Iparab(4971 4899

S Measre(1632 1116 1131 1149

S Mg(6159 11520 11530

S Mpwr(6336 6321

S Msoln(6054 5040 5217 6036

S Mtpt(6372

S Order(3264 777 1590 1593

S Path(867 426

S Pcalc(2628 1890

S Polar(6276 4863 5418 5427 5436 5565 5622
5646 6108 6129 6135 6171 6363 6417
6435 6438

S Pratio(5319 4950

S Preads(2493 1842 1854 1863

S Print(4020 3945 3987

S Prnt_sdev(4194 3990

S Prtpwr(1356 1293

S Pset(3456 3438

S Pwrmnt(0 1845

S Rect(6297 4350 5685 6426

S Redhed(4575 3641 3646 4419 4452 6640

S Redwrt(4689 3647 3765 4422 4428 4455 4464
6820 6850 11380

S Rfout(3390 1722 1869 1875 1881

S Rho2pt(4326 3891 3906

S Rhothu(4287 3873

S Rtpt(5985 5415 5484 5490 6408

S Rvgs(2238 1728 1731

S Stds2(5373 4947

S Synth(2826 3444

S T_disc(4821 3666

S Tr15(5445 4944

S W(	5709	4302	4344	4924	6165	6342	6381
S Wg(	6093	4305	4347	5382	5385	5388	5391
	5406	6138	6141	6168	6357	6393	
S Wq(	6117	4158					
S Wrp(	4851						
S Wrtbin(	4641	1280					
S Wrthed(	4494	1279	3764	4425	4461		

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10. SUPPLEMENTARY NOTES

☐ Document describes a computer program; SF-185, FIPS Software Summary, is attached.

11. ABSTRACT (A 200-word or less factual summary of most significant information. If document includes a significant bibliography or literature survey, mention it here)

A noise measurement system is being developed for the U.S. Air Force which uses coaxial cryogenic and ambient noise temperature standards to determine the noise temperature of the device under test. When the device under test has a different connector than those on the noise standards, an adapter has to be used. Adapter loss and complex reflection coefficient must be compensated for or noise measurement accuracy is affected. A technique has been developed which uses a dual six-port measurement system to determine the mismatch, loss, and ultimately the efficiency of the adapter used. This enables correction of measurement results and allows measurements to be made with an adapter with no degradation of accuracy.

This report describes this method of evaluating adapters and provides instructions for its use.

12. KEY WORDS (Six to twelve entries; alphabetical order; capitalize only proper names; and separate key words by semicolons)

adapter parameters, dual six-port measurement system, efficiency, loss, measurement technique, mismatch

13. AVAILABILITY

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